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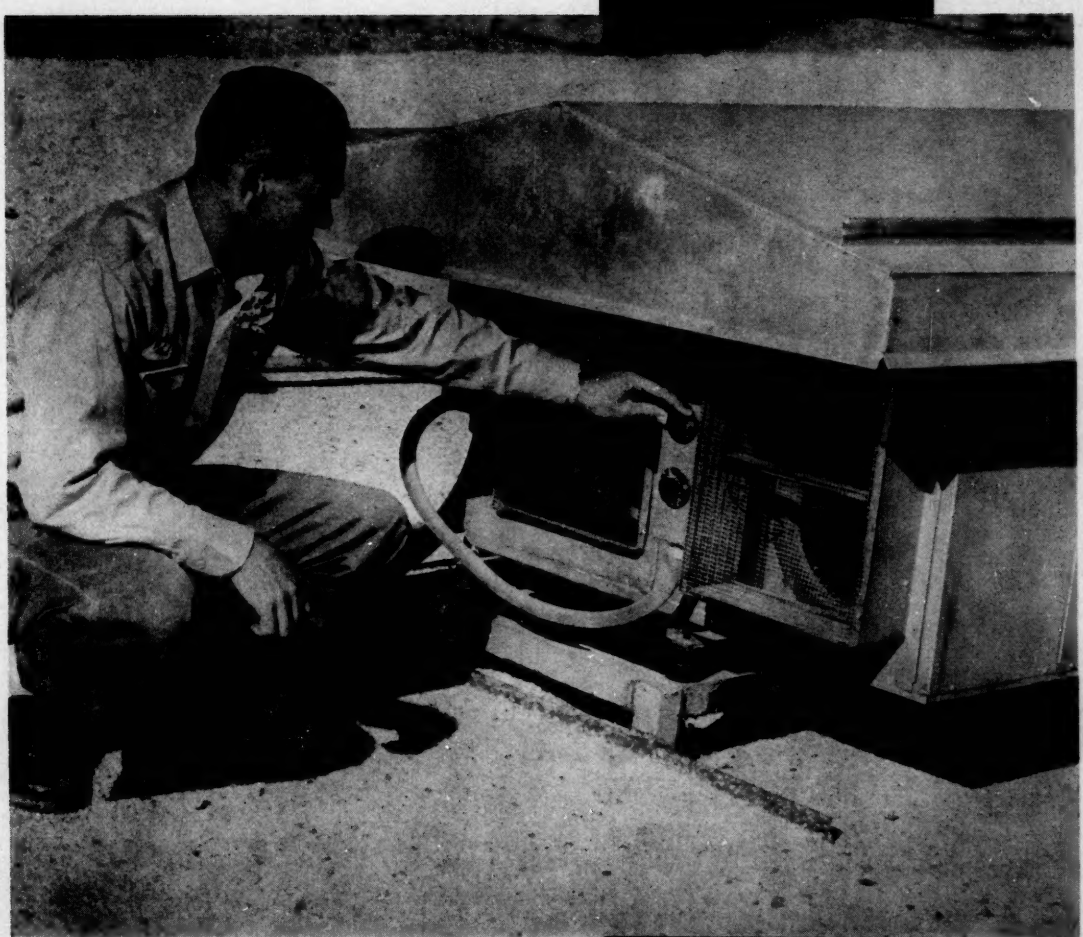
Refrigeration and Air Cooling Equipment

APRIL
1960

Industrial Refrigeration



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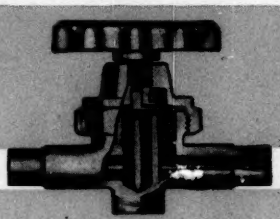

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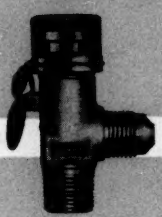

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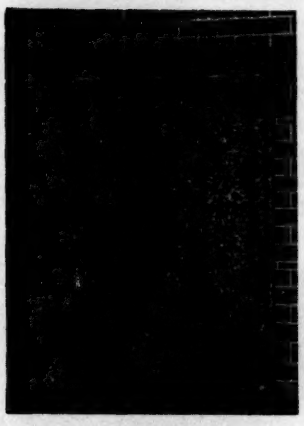

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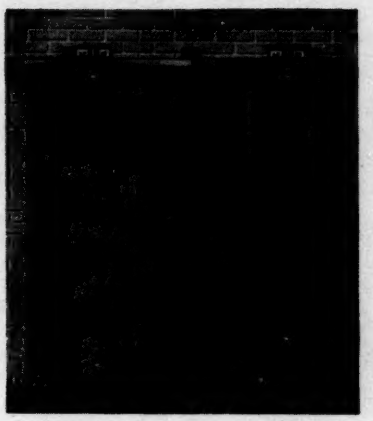

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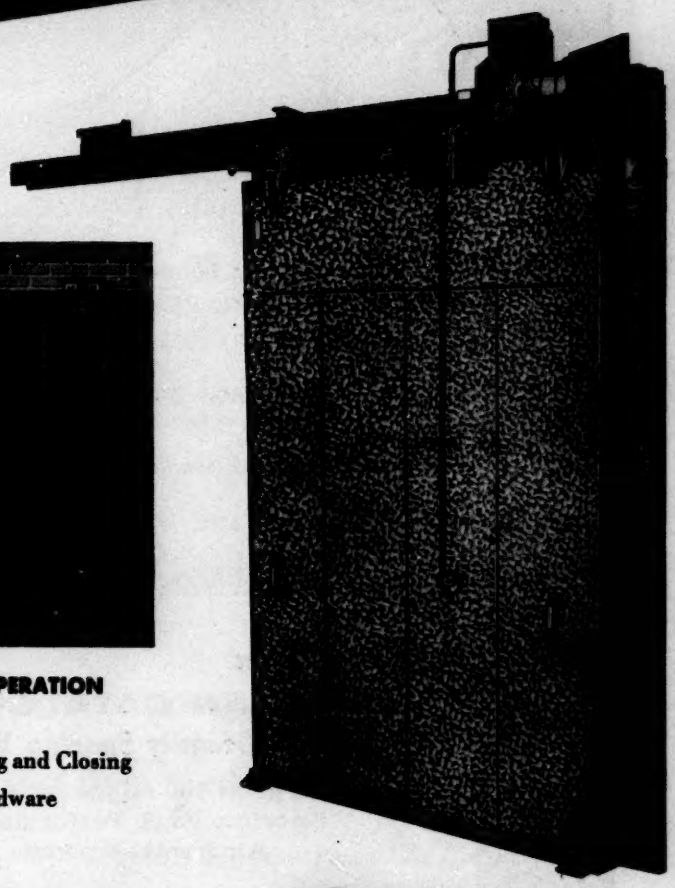

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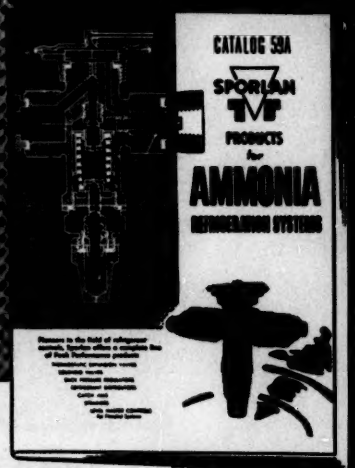

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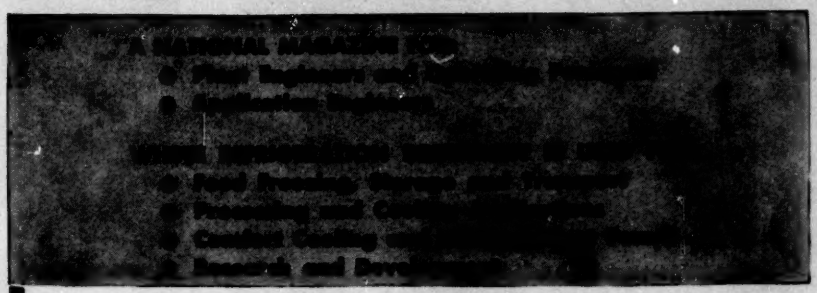
Industrial Refrigeration

April 1960



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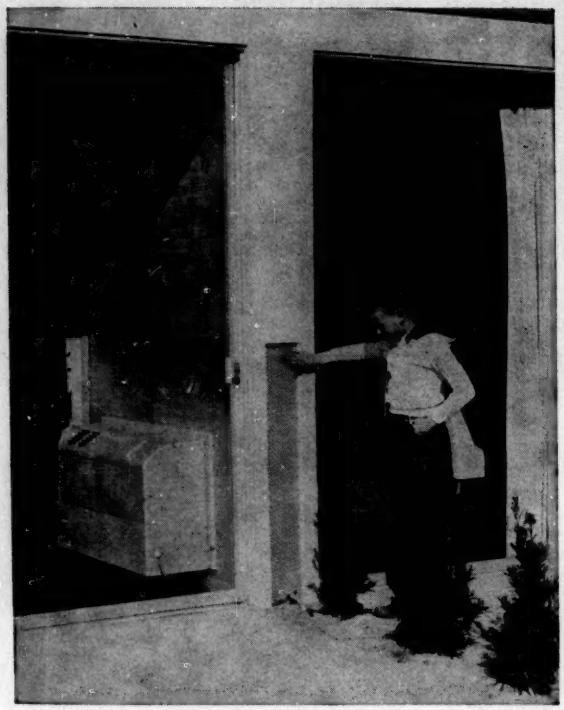
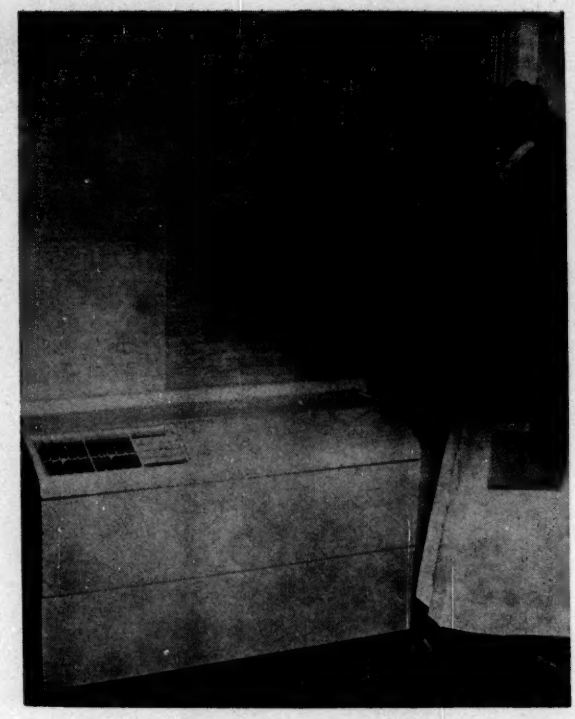
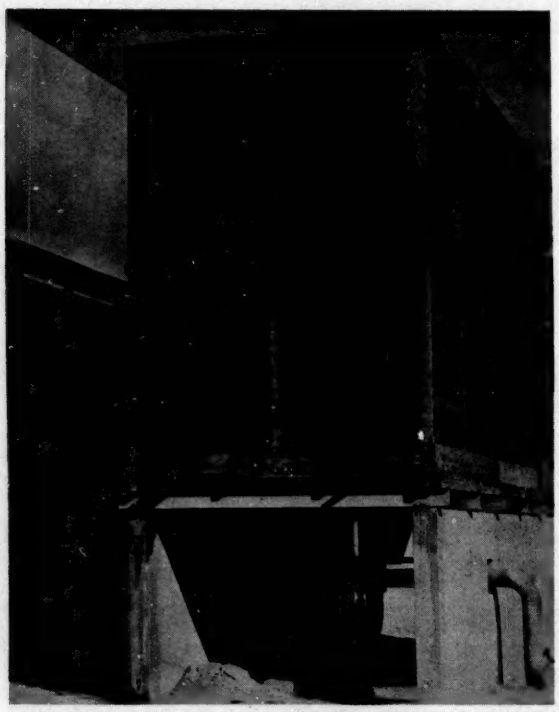


Console-type heat pump at Hilton Inn. The outside grille provides an intake at bottom, and the air is discharged at top. There is no danger of mixing, causing the heat pump to short cycle.



During their cleaning routine, maids check the temperature controls . . . later, the guest can adjust to conform to his own comfort.



Water tower with its circulating pump, serves the 125 hp compressor that cools the public areas.

New Hilton Inn Equipped With Heat Pumps

»» THE New Hilton Inn, adjacent to the El Paso, Texas International Airport, publicized as the Jet Age Hotel, has 150 heat pump units, each unit individually complete with it's own console-type heat pump.

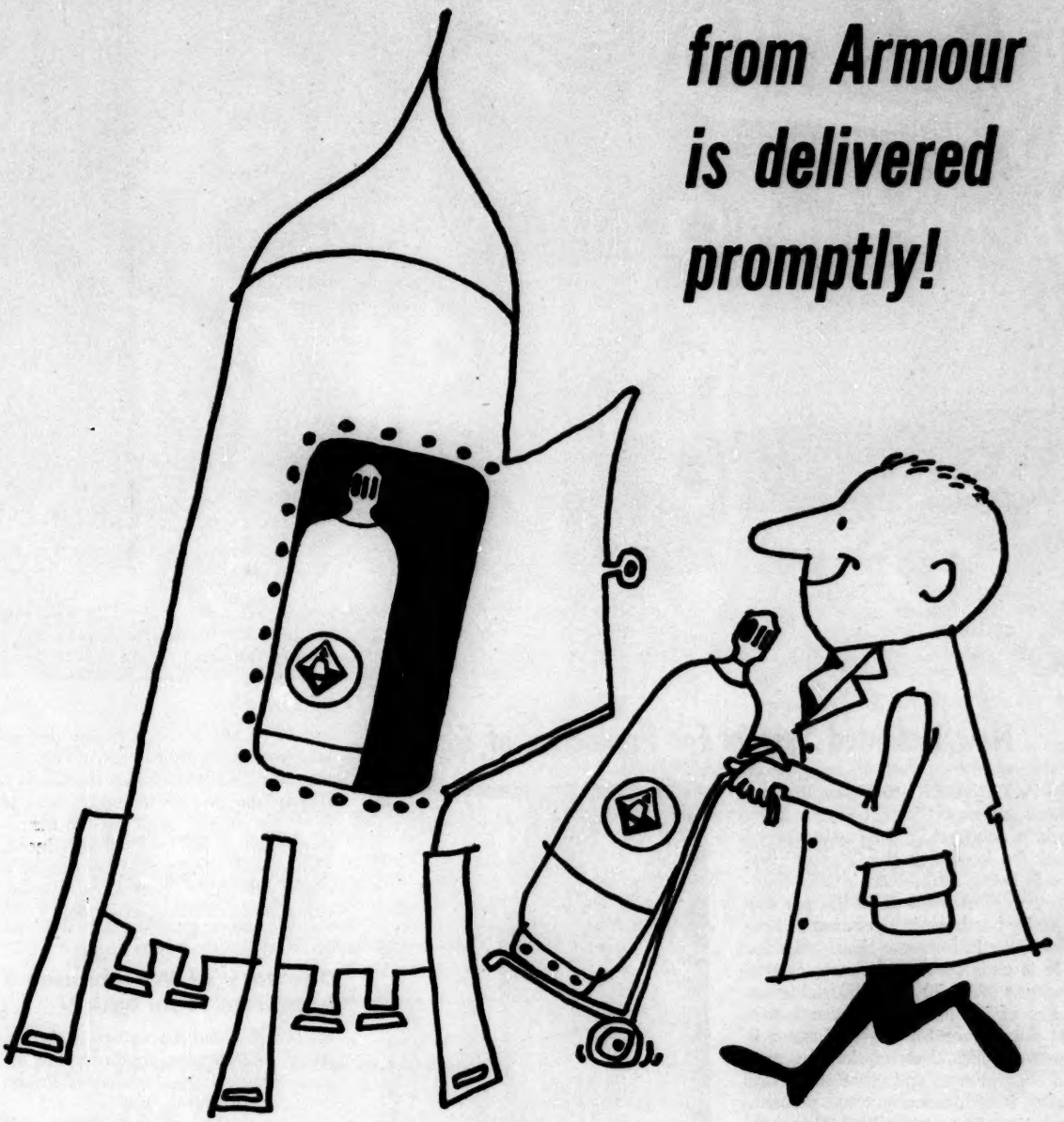
This type heating and cooling was chosen over a central plant by this veteran hotel management organization because if one unit goes down the whole heating and cooling system isn't down. Too, individuals can easily adjust their unit's temperature for their utmost bodily comfort.

Each individual console type heat pump has a 1 hp rating.

There is also a central plant, complete with water tower and 125 hp compressor, for cooling the public areas—lobby, ballroom, cafe, and the Skyriders Club.

The Hilton management is so well pleased with their room units, they placed an order for 1500 of the same type heat pumps to be installed in other Hilton Inns and hotels across the country.

Ammonia from Armour is delivered promptly!



Late deliveries can cause trouble in the form of low head pressures and cooling room shutdowns. To avoid trouble many users resort to stockpiling extra cylinders.

But you can rely on prompt delivery from Armour, because wherever you are, there is one of Armour's 171 stock points nearby, ready to meet your ammonia needs quickly. This nationwide network of distribution points allows you to deal with one supplier, no matter where your plants are located.

For your added protection, every cylinder and tank truck of Armour Ammonia is subjected to a rigid qualitative test *after filling*. This extra test eliminates the danger of your receiving ammonia that has been contaminated during the filling process—assuring you of consistent, high purity on delivery.

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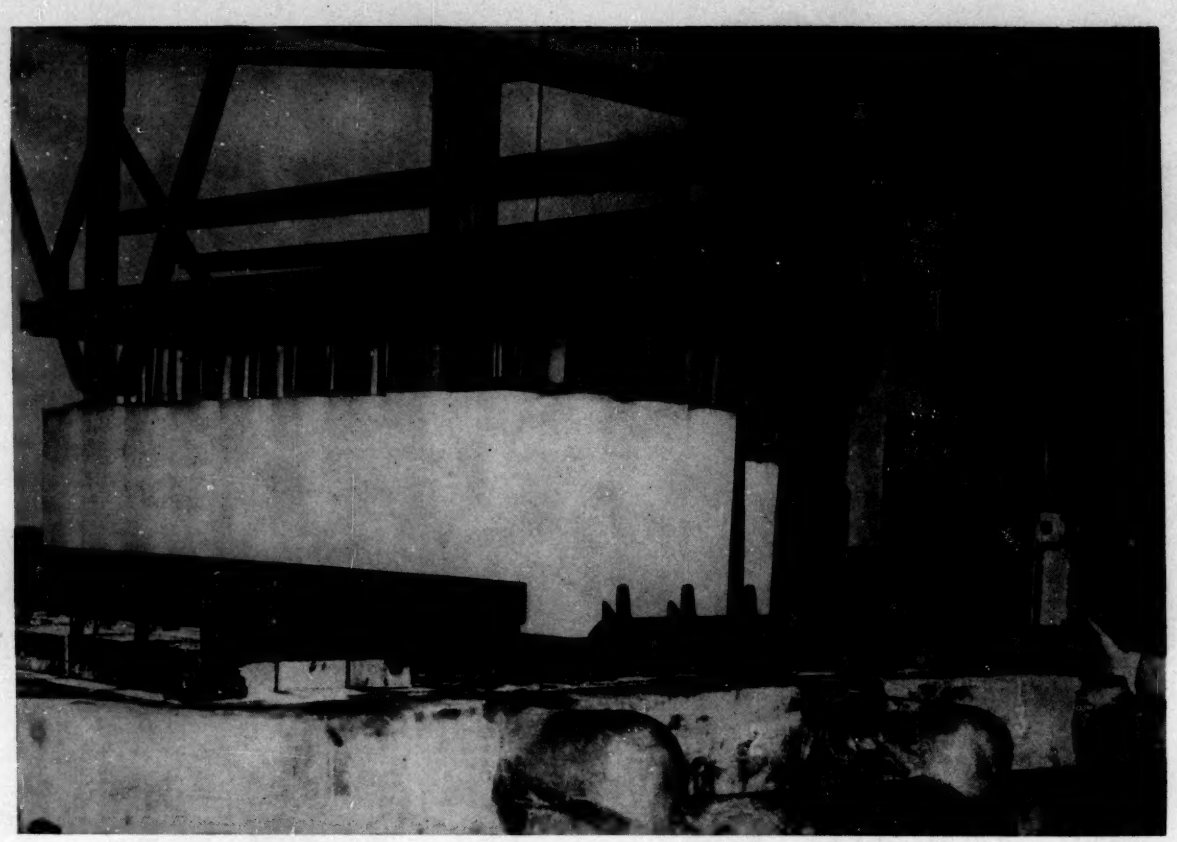


New Patented System For Production of Ice

»» ACCORDING to Debra, Incorporated, an export-import firm in New York, a new system for production of block ice known as the "Ramos" system is being introduced in this country. The pilot plant of 30-ton per day capacity has been in operation in Barcelona, Spain for some time.

It is claimed that the new system produces 25, 50 or 100 kilogram blocks of ice in two to three hours; that floor space for the equipment is about one-fifth that required by normal equipment and that electrical energy is reduced about ten percent. Operation is so simplified that one man can produce as much as 100 tons per day.

According to Debra, Incorporated, the delay in formation of block ice using standard methods is due to the fact that ice forms first on the surfaces of the molds and freezes toward the center of the block. The ice layer formed first acts to some degree as an insulator and slows up formation of ice toward the center.

The "Ramos" system uses several rows of molds of different sizes. Each mold represents one phase of the process. The system can include 4 or 5 phases depending on the weight of ice block and the speed of production desired.

The core of the block is formed in mold No. 1, which is the smallest one and the size of the block increases by steps by using gradually larger molds wherein additional layers of ice are frozen on the block until the desired size is reached. By the use of this system it might be said that the block is frozen from the center out instead of from the outside in. Thus the insulating effect of the ice shell is reduced.

Standard refrigerating equipment is used with this system, employing either brine or direct expansion.

Directory of Warehouses Available From NARW

THE National Association of Refrigerated Warehouses announce the release of their 1960 Directory of Public Refrigerated Warehouses.

This valuable guide is distributed free of charge to all users of public refrigerated warehousing space. The public refrigerated warehouses listed in this "who's who" of the perishable storage industry are dependable and reliable and are specialists in the storage and movement of perishable commodities requiring freezer or cooler space. The 500 plants listed totalling 400,000,000 cubic feet of refrigerated space represent locations throughout the United States, Canada, and several foreign countries.

Copies may be obtained by writing NARW, 1210 Tower Building, Washington 5, D. C.

Refrigeration Makes Delicate Cutting Job Possible

Cutting sheets of honeycomb structure made of .001" to .005" stainless into strips without deformation of the honeycomb can be a very delicate job. Thanks to refrigeration, called a "freeze chuck", it is being done at a rate of 12 ft. per minute. The honeycomb is kept filled with water or soap which is kept frozen on the table of a special milling machine during the milling operation. Carbide rotating cutters produce a clean, burr free cut, while the honeycomb is held rigidly in the freeze chuck.

Owners Preference In Piping Ice Rinks

»» OWNERS of ice rinks are largely agreed on some practices for the installation and maintenance of the grid pipe systems, but show considerable diversity of opinion on others.

Generally they prefer 1¼-inch or 1-inch pipe on 4-inch or 4½inch centers. A high percentage favors having the pipe lengths welded together. An even higher percentage favors brine as a refrigerant. As a base for the pipe, many rinks have a simple sand fill, but in other rinks such materials as crushed stone, concrete, asphalt, fiberglass, cork, and wood shavings are used, sometimes in combination with each other.

These facts were brought to light in a new survey conducted for the Tubular Division of The National Supply Company, whose Spang Steel Pipe is used in a number of ice rinks. In the survey, questionnaires were mailed to all artificial ice rinks in the United States and Canada, except small studio rinks. Replies were received from 193 rinks in the United States and 126 in Canada. Of these, more than half use steel pipe.

Details concerning the steel pipe rinks, including many in which the pipe has served for 20 years or more, are contained in the fourth edition of "Steel Piping in Ice Rinks," just published by The National Supply Company.

In all the rinks covered in the survey, at least one dimension of the ice surface is 100 feet or more. More than half of the rinks from which reports were received are 85 by 185 feet or larger. The largest "artificial ice" rink of all is believed to be the speed skating oval for the 1960 Winter Olympic Games, at Squaw Valley, Calif., which measures 600 by 300 by 45 feet. This rink uses steel pipe to carry the refrigerant.

Sand bases are used for more than 50 of the rinks, but a combination of two materials is used for 75 rinks, and a combination of three or more materials for more than 30 rinks.

The most common pipe diameter reported is 1¼-inch, followed closely by 1-inch, but other diameters range from ½-inch to 8-inch. The most common separation between centers is 4-inch, followed closely by 4½-inch, with others ranging from 1½-inch to 12-inch.

Regular mill coated pipe was reported used in about twice as many rinks as specially coated pipe. Pipe lengths are joined by welding in about 85 per cent of the rinks; in the others they are joined by threads and couplings.

Brine is used as a refrigerant in more than 90 per cent of the rinks covered in the reports, and about 75 per cent of these rinks use corrosion inhibitors in the brine.

Scotsman Offers New "Ice-Idea" Booklet

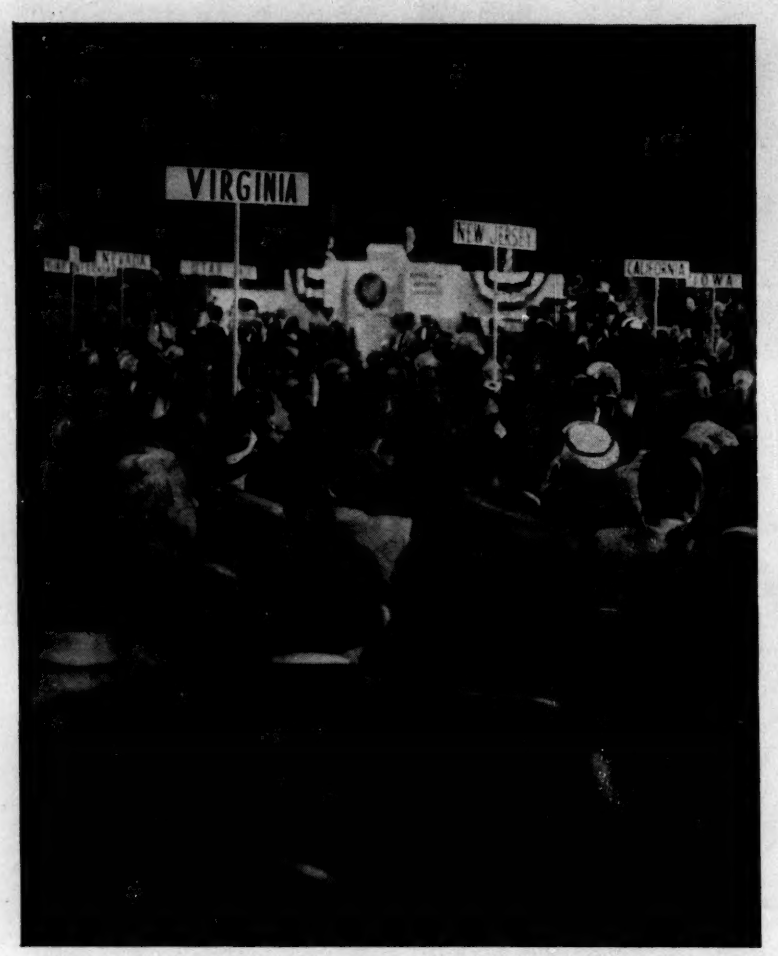
»» A COMPREHENSIVE 48-page booklet describing modern ice-making machines and how to use them to increase profits is being offered free on request by the manufacturers of Scotsman Ice Machines.

Entitled "New Ideas on Ice," the new booklet contains a wealth of information—including more than 80 illustrations—on practical applications of ice and on the machines that make it.

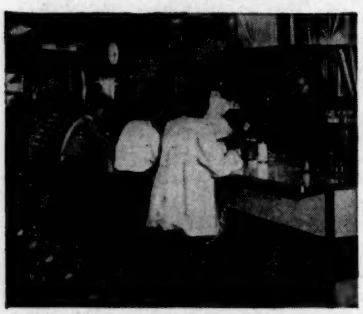
More than 40 different types of business which are now using ice machines to profitable advantage are covered in an interesting helpful-hint and photo-story fashion. Also described is the complete line of Scotsman machines—more than 60 models of cubers, flakers, storage bins and crushers. Capacities range from 50 pounds per day to more than two tons of ice per day.

To get "New Ideas on Ice", simply write Scotsman Ice Machines, Queen Products Division, King-Seeley Corporation, Albert Lea, Minn.

In convention halls, coffee shops and commuter trains...



Heated discussion is still a convention trademark, but physical swelter has given way to air-conditioned comfort in giant convention halls. The amount of air-conditioned space needed for meetings and exhibits often has a bearing on the location chosen for major conventions.



Quick snacks and coffee breaks are bread and butter to the modern air-conditioned "coffee shop"—a relatively new and thriving institution in busy urban centers.

Brow-mopping days are over for many train travellers, thanks to air-conditioning. Air-conditioned cars pay off in increased traffic—and immeasurable good will.

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MONOCHLORODIFLUOROMETHANE

genetron 113 PURPLE LABEL $C_2Cl_3F_3$
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GENERAL CHEMICAL DIVISION
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Allied Chemical

news briefs of the month

Ultrasonics Make 'Fresh' Milk Available Anywhere

Ultrasonic wave treatment of frozen milk, a recent British discovery, has made it possible for anyone anywhere in the world to enjoy a glass of "fresh" milk, declares Food Engineering. A London dairy company, which holds the initial license to the patented process, expects to produce 100,000 imperial gallons of the fresh frozen milk per year. The milk, nearly identical in taste to the fresh variety, will be sold in countries where fresh milk is unobtainable. Markets are already being supplied in the Middle East, Ghana, Nigeria and Singapore. The treatment of freshly pasteurized whole milk by inaudible sound waves before it is quick frozen, it is said, prevents the milk from separating when thawed, protects its fresh flavor and extends its frozen shelf-life indefinitely.

Asian Theater Adds Scents For Audience Appeal

When a theater in the Asiatic nation of Cambodia recently remodeled and installed air conditioning, they went one better and perfumed the air in the showhouse as well. The air conditioning-perfuming was part of an extensive project which made the Casino Theater, Phnom-Penh, a movie palace which might be the envy of many American cities. The particular exotic scent used is called "atmosphere printannaier" (air of spring) and an ad in the "Echos de Phnom-Penh" announcing the innovation says it is a fragrance designed to refresh the theater without being too heady for the moviegoers. Trane equipment was installed.

Patient's Heart Still 97 Minutes In Notable Operation

A cardiac operation under the deep hypothermia in which the patient's heart stood still for 97 minutes was recently performed in Stockholm at the Academic Hospital, Upsala, according to Swedish press reports. The patient, a 20-year-old woman suffering from aorta insufficiency, has now left the hospital fully restored. The temperature of the patient was lowered to 12-14° C (54-57 F). In that state the need of oxygen is only 5 percent of the normal and the heart completely relaxed. While the heart was out of function the work of blood circulation and the oxidation of the blood was taken over by the Aga heart-lung machine. The operation was undertaken by Asst. Prof. Viking Olov Bjork, who introduced the deep-hypothermia method in Sweden a year ago.

Chicago Post Office To Be Air Conditioned

An air conditioning system with sufficient capacity to cool 2,500 average six-room homes will be installed by the York Division of Borg-Warner Corporation in the Chicago Post Office Building. The agreement covering the installation is believed to be the largest single contract for refrigeration equipment ever placed in the Chicago area. The system includes two 2250 horsepower and one 1250 horsepower Turbo-Master water cooling units. The smaller one is scheduled to be put into operation July 1 and the other two about November 1. George D. Hardin, Inc., is the prime contractor on the project.

Birds Eye Division Builds New Food Plant

Birds Eye Division of General Foods Corp., announced plans to build a $2,000,000 processing and refrigeration plant in Canandaigua, N.Y., to produce baby-foods. Construction of an initial facility of 180,000 square feet will begin shortly. Expansion plans call for construction of an additional 100,000 square feet of facilities at a later date.

New Insulating Method Extends Life of Motors

Experimentation with new insulating materials and vacuum molding processes has developed a new protection for motor windings functioning under adverse environmental conditions where conventional motor insulations have short life expectancy. In the process of providing the new protection the stator is enclosed in a mold and liquid epoxy resin is injected under vacuum so that there are no air pockets to retain heat and decrease protection. Each winding is permanently and individually sealed. Encapsulated windings have been exposed to radical temperature and humidity changes being cycled from a hot and dry environment to a low temperature at 100 percent humidity and receiving both short and prolonged voltage surges. In this way years of duty are simulated by accelerated tests which proved the new protection provides several times the life of standard insulation.

F. W. Badger
Asst. Chief Engineer

J. F. Martin
Asst. Chief Engineer

This is the first of a two-part article presenting a study of causes of failures to air conditioning equipment, with suggestions for reducing the number of preventive failures by establishing an adequate preventive maintenance program. The article is the result of a study made by The Hartford Steam Boiler Inspection and Insurance Company and was originally published in their paper "The Locomotive". Authors are pictured on this page. Part I is a discussion of the major defects. Part II will discuss a continual preventive maintenance program.

Preventive Maintenance For Central Air Conditioning Systems

»» IN little more than 35 years, comfort air conditioning has grown from a novel luxury into a modern science and industry employing thousands in the design, manufacture, distribution, operation and maintenance of equipment contributing to the comfort of millions.

As expected, many methods are now available, but it is generally agreed that there is no "best" method to air condition all buildings. Thus, because of the variety of air conditioning systems now in use, this discussion will be confined to the large central air conditioning systems using electric motor driven reciprocating compressors (excluding the hermetically sealed motor-compressor units) and one of the chlorinated hydrocarbons as the refrigerant. The air handling equipment discussed will also be of central system type.

It has become more or less standard practice for operating, maintenance and service personnel to divide central air conditioning equipment into five general classifications: (1) machinery equipment, (2) refrigerant circuit, (3) condenser water circuit, (4) chilled water circuit and (5) air filters and ducts.

However, from an insurance company's point of view, coverage of the systems under discussion is provided under two general categories: (1) Refrigeration systems (vessels and piping containing refrigerant with the option to extend the coverage to include chilled water piping) and unfired vessels; and (2) electric motors, miscellaneous electrical apparatus (control equipment), compressors, pumps and fans insured as individual machinery objects. Other components, such as cooling towers, dampers, certain controls, filters and duct work, will enter into the discussion only as their operation and maintenance may affect the operation of the equipment in the aforementioned two general categories.

In any event, the prerequisites for safe and satisfactory service of any air conditioning system are adequate design, proper application, installation, operation, maintenance and regular examination by individuals qualified to recognize the early symptoms of trouble.

In general, sufficient experience has now been gained so that the various components of present day central air conditioning systems are adequately designed and properly applied and installed. Thus it is the intent of this study to bring to the attention of the reader some of the conditions incident to operation that cause failures, as a means of pointing the way to a more effective accident prevention program.

Refrigerating Systems

When an air conditioning system is to remain idle for an extended period, it should be "pumped-down" to decrease the possibility of losing a large amount of refrigerant through leakage at compressor shaft seals or pipe fittings, joints, or connections.

While the pumping down procedure is not a complicated operaaion there are several precations that should be observed, and the manufacturer's instructions for the particular system should be carefully followed. Otherwise various complications may be encountered, which may later affect the satisfactory operation of the refrigerant circuit. For example, moisture laden air that could damage expansion valves, or other controls, may enter the system inadvertently, through compressor shaft seals or minor system leaks should a vacuum be drawn on the suction side. If a compound gage is not already installed on the suction line near the compressors, it is suggested that such a gage be installed, to thereby enable the operator to maintain a slightly positive pressure on the suction side of the system during the pumping down procedure.

Immediately after the pumping down, the valves on the receiver or condenser containing the liquid refrigerant should be closed. This vessel should then be thoroughly checked for leakage of refrigerant by use of a halide torch. A slight positive pressure in the other parts of the refrigerant circuit should be maintained, after pumping down, to prevent the entrance of air.

A recent review of failures to refrigerant circuit components revealed that 13 failures were due to freezing resulting from improper draining. Thus, it is evident that condensers, coolers, evaporative condensers, heat transfer coils in air handling units, and connected cooling water or chilled water piping installed in locations where ambient temperatures can be expected to fall below freezing, must be carefully drained. Failure to properly protect such objects almost invariably results in ruptured tubes, cracked tube sheets, broken piping, and is sometimes followed by water damage to adjacent property.

Shutting off the water lines and opening drain and vent valves seldom afford assurance that water-containing equipment is sufficiently dry. It is usually necessary to clear the water spaces of each piece of equipment by the use of compressed air at about 50 pounds pressure. All drains should be kept open until the flow of water ceases. Even then it is good practice to wait a few minutes for the moisture within the water passages to condense and then to use compressed air a second time.

Causes of Recent Air Conditioning Failures

	Freezing	Corrosion	Erosion	Vibration	Defective Material	Workmanship	Other
Chillers	33	3	2		3		1
Condensers	5	9	1	1	2		2
Control Piping			1	18	4	8	1
Refrigeration Piping	2	1	6	37	4	8	1
Chilled Water Piping				2	1		
Heating Coils	11	1					
Chilling Coils	3						
Evaporative Condensers				1	1		
Expansion Valves			1		4		
D.E. Evaporators				1	2		
Totals	54	14	11	60	21	16	5

Frequently, certain vessels and piping are not properly pitched for complete drainage. In some cases it may be necessary to remove condenser heads, disconnect water regulator valves, adjust pipe hangers, or replace vessel supports that have become sagged because of weakness from rust or corrosion before the system can be freed of water.

If a supply of compressed air is not readily available or if there is any doubt about the effectiveness of the draining procedure a strong antifreeze solution (such as methanol or ethlyene glycol) can be used to fill the water space of each such object. Since a considerable quantity of antifreeze may be necessary, if other parts of the system are to be winterproofed, it is economical to drain off the solution for reuse, after completely filling each such object to the level of the vent. This method assures that all pockets formed by flange bosses or other construction features then contain a small amount of antifreeze solution.

Once the water has been drained from the components of the air conditioning system an opportunity for preventive maintenance presents itself, which is not available at any other time. The condenser heads may then be removed and the tubes brushed. In this cleaning operation the use of a nylon tube brush or its equivalent is suggested as the bristles do not scratch the inside tube surfaces. Scratches should be avoided because they serve as focal points for corrosion attack. After brushing, the tubes should be examined for corrosion in the form of pitting, erosion from sediment in cooling water or for other damage or defects. Any tubes judged to be unreliable should be replaced.

Unless the cooling water has been properly conditioned, scale formations may be found in the tubes. It may be necessary to resort to chemical cleaning to remove these deposits. However, scale removal by this method, with some exceptions, should be undertaken only by a firm specializing in chemical cleaning.

An adequate supply of cooling water for condensing refrigerant and cooling compressors, in many installations, depends on the proper operation of a cooling tower. Again, shutdown of the system permits inspection of the tower for rust spots on the pan, loose packing, defective float valves, clogged spray nozzles or other parts requiring cleaning, painting, repair or replacement.

Until fairly recently, air cooled condensers were used only in the smaller systems. However, air cooled condensers of at least 300 ton capacity are now being manufactured and the use of waterless condensing is increasing. While the danger of freezing is not a problem, certain maintenance procedures are necessary if the equipment is to continue to operate at maximum efficiency. Heat transfer between the refrigerant within the coils and the rapidly passing air stream over the coils can be effec-

tive only if the tube banks are kept clean. Compressed air or water should be used to clean off dust deposits at regular periods, governed by the amount of fouling encountered.

Evaporative Condensers

Many present day installations use evaporative condensers which are a combination of the air cooled and water cooled types. While the freezing hazard is primarily confined to water lines the draining of the sump does allow maintenance not practical while the equipment is being used. The water sump may be cleaned and painted, the eliminators removed and cleaned, lime deposits hosed off, float valves and spray nozzles examined and repaired.

In addition to examining the water side of coolers or chillers for evidence of pitting and erosion, the idle period affords an opportunity to replace any controls that have given chronic trouble during the past season. Freezing accidents of this type of exchanger were unusual in that 23 out of the 33 failures, recently recorded, were caused by control failure. In several cases low limit switches were inadvertently set too low but in other cases it was found that the thermal bulbs were not properly located. During the off season such controls should be calibrated, relocated or replaced as found necessary. Adjustments or changes should be made only by persons thoroughly familiar with the controls and their applications.

Heat transfer equipment in the air handling apparatus includes, in addition to the chilled water coils referred to, so-called direct expansion coils. These coils, while not subject to freezing should be cleaned with an air hose at least once a year. Evidence of corrosion, rust, erosion, loose bolting or other defects should receive attention to maintain efficient operation.

Since air conditioning often employs heating coils, such as tempering, preheat, and reheat coils that use steam or hot water, they too may require attention if they are to be idle with the rest of the system. Essentially the same draining procedure is required as with coils using chilled water. Ironically enough, steam coils experienced 4 times as many freezing accidents over the past three years as coils employing chilled water! Poorly fitted dampers or lack of adequate interlocks between dampers and fans usually were at fault.

Machinery Equipment

The first installment of this two-part article deals especially with the defective conditions which usually may be more conveniently found and corrected during the winter months. However, with rotating components of air conditioning systems, defects and subnormal conditions develop and exist during operation, and unless foreseen and given attention in time to avoid failures, they may shut down the system when it can least be spared. For that reason, although the conditions about to be discussed can best be given serious attention during the idle period, they are of such importance that they should be put into a plant's all-year maintenance schedule.

The figures shown in the accompanying tables are based on The Hartford Steam Boiler Inspection and Insurance Company's statistical analysis of failures of 4943 motors, reciprocating compressors, centrifugal pumps and fans. Although these objects were in use for a variety of purposes and were located in many kinds of plants, the accident-producing conditions were similar to those encountered in like equipment forming parts of large central air conditioning systems. Thus the data used in this discussion is fairly indicative of the types of failures to be expected and the relative frequency of their occurrence.

All investigations represented in the tabular analysis were made by inspectors who are experienced in determining from the available evidence, the part which failed first and the direct cause of the failure. In considering the part which failed first one should not lose sight of the fact that many accidents initiate a chain reaction in which major parts of a motor, compressor, pump or fan may fail or be badly damaged as a direct result of the initial failure of a small, rather inexpensive part. For example, a motor bearing failure may entail only replacement of the bearing or it may lead to such extensive damaging of other parts that the whole motor must be replaced.

Motors

The number of failures resulting from moisture may be surprising to some, but a relatively small amount of moisture absorbed by the insulation of electrical equipment will often set up hazardous conditions that may cause a serious failure. Since it is believed all winding failures attributable to moisture should be classed as preventable, it is disturbing to record that since 1949 the percentage of such failures has increased from 13% to approximately 21%—better than a 50% increase. Obviously, all practical precautions should be taken to keep windings dry.

Failure to properly dry out the windings of motors after prolonged idle periods resulted in 26 accidents. The period of time a motor may stand idle without windings absorbing moisture depends, of course, on relative temperatures and the quantity of moisture present in the surrounding atmosphere. The best means of prevention is to maintain the temperature of the idle motor a few degrees above that of the surrounding atmosphere, thus keeping moisture from condensing on the windings. It has been the company's experience that this can be best accomplished by the use of self-contained electric space heaters. Such heaters are available in various sizes, and can be placed in service quickly, usually at low cost. The heaters should be located preferably under the motor, and so placed as to allow even distribution of heat along the entire length of the machine. Also heated air may be blown over the windings to keep them dry, but this requires a heating device for raising the temperature and a blower to circulate the air. In some cases, ordinary light bulbs will supply sufficient heat if the motor is covered with a tarpaulin vented at the top to permit proper circulation of the heated air. However, if any of such methods are used, precautions should be taken against damage by fire.

Failures due to deterioration of

insulation result from causes incident to age and operating conditions. Although insulation is the most important part of electrical equipment in determining its useful life span, it is the part about which the least is known as far as its actual condition or the additional service that may be obtained from it are concerned.

The extent to which the insulation has deteriorated is of first importance and, in judging the condition of the insulation, two properties are of primary concern; mechanical strength and value as a dielectric (or insulator). However, as electrical failure of insulation is generally preceded by mechanical breakdown, many failures can be prevented by thorough examination of the windings by men who are trained to recognize the weak points of insulation and the symptoms of impending trouble. Brittleness or the lack of sufficient mechanical strength can be determined by "feel" tests. In such tests an attempt is usually made to handle any protruding pieces of insulation which then may be carefully flexed. While it is not always true that the entire insulation is deteriorated when the accessible parts are found to be brittle or lifeless, the condition of remaining insulation should be suspected.

On too many occasions a motor is continued in service beyond the normal anticipated life of its windings until it fails in operation. Many times this false economy results in severe damage to the laminations as well as burned out windings.

Grease or oil on the windings will cause deterioration by attacking certain materials. Dirt and other foreign substances on the windings and in the air passages can cause rapid deterioration by increasing the operating temperature. Since a reasonable amount of maintenance will prevent failures resulting from accumulations of foreign substances on the windings and in the air passages, it is believed that the 193 accidents from this cause should be regarded as inexcusable. Serious accumulations of dust, lint, oil, grease and other substances can be prevented by periodic cleaning at regular intervals. Also, the cause of the trouble often can be corrected at the source and the entire problem thus eliminated.

ROTATING EQUIPMENT

Listing only the initial parts involved in the majority of the failures and the principal direct causes of failure.

Failures		Direct Causes of Failure	
MOTORS (3488 Analyzed)		*MOTOR WINDINGS*	
Initial Part	*Number*	*Cause*	*Number*
Windings	2465	Moisture	524
Bearings	550	Deterioration of Insulation	425
		Line Surges (Lightning, etc.)	341
		Foreign Material (Dirt, grease, etc.)	193
		Overloading	160
		Failure to Maintain Control or Protective Devices	75
COMPRESSORS (1246 Analyzed)		*MOTOR BEARINGS*	
Valves	427	Inadequate Lubrication	346
Bearings	293	Excessive Belt Tension	61
Shafts	102		
Connecting Rods	17	*COMPRESSORS*	
Pistons	84	Metal Fatigue (Progressive crack)	546
Piston Rings	21	Inadequate Lubrication	277
Cylinders	67	Liquid in Cylinders	172
Cylinder Heads	15	Misalignment	35
Fastening Devices	85	Improper Adjustment	28
		Improper Operation	23
CENTRIFUGAL PUMPS (114 Analyzed)		*CENTRIFUGAL PUMPS*	
		Metal Fatigue (Progressive crack)	28
		Inadequate Lubrication	20
Shafts	46	Foreign Object entering Casing	11
Bearings	27	Misalignment	10
Impellers	17	Loosening of Fastening or Locking Devices	6
Casings	6		
FANS (95 Analyzed)		*FANS*	
		Metal Fatigue (Progressive crack)	26
		Inadequate Lubrication	24
		Excessive Vibration	9
Blades	43	Loosening of Fastening or Locking Devices	8
Bearings	39		

Although accidents to stator windings are more frequent, rotor failures are often more costly. While certain major causes of failures to stator windings, such as moisture, deterioration of insulation, and accumulations of foreign substances, also lead to trouble on rotors, there are other causes of failures which apply primarily to the rotors.

The polyphase motors used with central air conditioning equipment are of three types; squirrel cage, wound rotor and synchronous. Squirrel cage rotors have always been considered as having the most foolproof of motor windings. They consist merely of metal bars (brass, copper, aluminum) inserted into the slots of the assembled rotor laminations and joined together to rings at both ends of the rotor. The bars and rings may be either bolted or welded together, or cast as a unit. In spite of this simple and more or less rugged construction, however, they do fail, often from preventable causes.

Periodic analyses reveal that approximately 75% of all squirrel cage rotor failures occur either in the rotor bars or in the end rings to which the bars are connected, with the remaining failures chiefly involving fans which are part of the rotor assembly. Abnormal operating conditions (which will be discussed later) set up stresses in the bars and end rings that may cause small cracks of a progressive nature which can eventually lead to failure unless they are promptly discovered and properly repaired.

The majority of the failures of windings of wound rotors occurred to connectors at the coil ends. Periodic inspection of the installation of the ends of the coils is advisable as local heating at these points (from adverse operating conditions —to be discussed later) will cause rapid deterioration of the insulation which may then become brittle. Pressing one's finger against the wrappings on the end connections will indicate whether the insulation is brittle. If only the coil-end insulation is brittle it may be

removed, the coil-end connections carefully examined and repaired as the conditions observed may warrant, after which adequate new insulation should be properly applied. Otherwise, the rotor should be completely rewound.

Several wound rotor failures resulted from the breaking of banding wires. In some cases the neglect to occasionally check them, accompanied by the drying out of insulation under the bands, resulted in looseness which permitted the coils to move under centrifugal force. When this happened, a short circuiting of the winding usually resulted, further causing a burning apart of the band wire material, serious damage to both rotor and stator insulation, and occasionally damage to the iron. In other failures the band wires sustained mechanical damage from rubbing on the stator laminations because of worn bearings. In still other cases careless handling during disassembly or reassembly produced nicks. A concentration of stress at such nicks caused the failures.

Synchronous Motors

Almost all of the failures to the rotors of synchronous motors occurred to the field coils, the connections between field coils and the amortisseur windings. In several cases the field coils failed from mechanical damage, such as is produced by vibration and centrifugal force, the latter causing the coils to bulge or, if loose, to move on the field poles. Either effect will produce short-circuited or grounded windings.

Careful visual inspection of the field coils at regular intervals could have prevented a number of the failures. Any looseness of the field coils on the field poles should be corrected as soon as detected. If the windings are in good condition, the installation of additional thicknesses of insulating collars will restore the tightness, but if the looseness is due to a serious aging of the insulation and resultant shrinkage, it may be necessary to completely rewind them.

The company has found many cases in which the sides of the field coils were so bulged out that the turns on one coil were in contact with those of the adjacent coil. Such distortion permits some of the individual turns to loosen and chafe and ultimately to become shorted. Distortion of this nature is of a progressive character, and it is important that such trouble be detected when it begins to develop, so that the proper corrective measures may be taken before a failure occurs.

Tests For Field Coils

If there are any indications of field coil trouble, such as bulging, looseness of pole pieces or brittle insulation, then a simple drop-of-potential comparison test should be made by using a source of D.C. excitation of constant value and comparing the voltage drops across the individual field coils. The values should not vary more than 5% between individual coils. Field coils with shorted turns should be promptly replaced. A good preventive maintenance program should include a drop-of-potential comparison test at regular intervals.

The troubles experienced with the field coil connections stemmed from several factors, such as poor contacts, lack of sufficient flexibility in the connections between the coils and lack of proper support of the connections. Warnings of such troubles are often given in the form of overheating of the insulation and connecting points prior to final failure. (High resistance at connections produce localized heating which tends to age the insulation rapidly, and cause it to become brittle). Although in a number of the cases studied, proper protective relays did remove the motor from the line when the connection opened during operation, the arc caused by the break resulted in a severe burning and necessitated the rewinding of one or more field coils.

The amortisseur winding failures were similar to those previously discussed for the windings of squirrel cage rotors.

If originally supplied with the controls by the manufacturer, a field discharge resistor is a most important protective device that is cut into the circuit across the collector rings whenever the field switch is opened. The purpose is to protect the field against induced voltages that would otherwise be produced in the field circuit, often leading to insulation breakdown, particularly in the lead coils. These devices are occasionally found improperly connected and thus ineffective. However, even though properly connected, they should be periodically checked for open circuit and general condition.

Because a discharge resistor is a protective device for the field winding, and because an improper value will affect the motor starting characteristics, a defective discharge resistor should be replaced only in accordance with the manufacturer's specifications.

Inadequate maintenance of control and protective devices was found to be the direct cause of 75 motor winding failures. Thus the importance of such devices being carefully inspected, properly adjusted and otherwise overhauled as conditions observed may require, at periodic intervals, is self-evident.

Although the major cause of bearing failures will be discussed later, obviously, any worn or defective bearing should be replaced before a motor is returned to service.

Reciprocating Compressors

Valves failed initially in 427 (35% of the total) of the cases studied, indicating the urgent need of taking precautions to reduce such failures. In 149 of the cases only the valves were damaged, but the greater number, 278, resulted in serious damage to other parts such as pistons, cylinders and crankshafts.

In some modern high speed compressors, valve parts are required to withstand over 300 million stress reversals within a year, even if the compressor is in service only 50% of the time. Obviously, the best alloy steel may be expected to show some signs of stress and wear after such service, and for this reason most manufacturers recommend that valves be inspected at maximum intervals of one year. Barring other reasons such as failures resulting from material defects or liquid refrigerant slugging, the failure of a valve which has been in service for a longer period without an inspection may be attributed to fatigue and lack of maintenance. A good preventive maintenance program should in-

clude inspection and servicing of the valves at least once each twelve months. It is considered good pratice to record any changes, repairs or replacements made.

The breaking of a crankshaft or connecting rod is a serious failure because it usually causes extensive damage to other parts of the compressor, and it can almost invariably be traced to one or more of the following: misalignment, shock load (such as may be caused by bearing or piston seizure, or liquid in the cylinders) or improper repairs. In only a very few cases did failure result from defective material or poor design.

Misalignment

Misalignment resulted in most cases from improperly fitted or badly worn bearings which caused excessive bending stresses in the shafts or rods. Since misalignment is a condition which becomes progressively worse, the only way to prevent breakage is to detect and correct the condition early. A good preventive maintenance program should include disassembling the compressor, for inspection and servicing of bearings and journals, crankshafts, connecting rods, pistons and rings, cylinders, lubricating systems, etc., at least every 16,000 operating hours or two years, whichever occurs first.

In the larger machines, misalignment may also be caused by a poor or settling foundation or deteriorated grouting. These conditions can usually be detected by a visual inspection and by the use of levels.

The crankshaft may also be excessively stressed by misalignment between the compressor and the driving motor, or by overly tight belts. These conditions can be detected and corrected by methods known to competent maintenance mechanics or servicemen.

In the few cases in which improper repairs caused the breaking of connecting rods or crankshafts it was found that the parts had been fusion welded. The repairs consisted of building up scored or worn journals, scored shaft seal areas or repairing cracks and casting or forging defects in the shafts or rods. The parts so repaired failed in either the welded or adjacent areas. The company's experience shows that when such machine parts are fusion welded, even if done under the most closely controlled conditions, they will eventually fail. The elimination of this type of failure is simple—no fusion welded repairs should be made to these parts.

Most of the piston ring failures resulted from fatigue or excessive wear. Prolonging the service of worn piston rings invites failures. Cylinders and pistons are often severely scored or broken by pieces of piston rings jammed into the clearance spaces at the end of the cylinder. A broken ring is a minor failure, but its neglect often leads to a major failure. Usually the instruction book supplied with the compressor contains the maximum permissible wear of piston rings.

Scored pistons and cylinder walls, even if only of a minor nature, should receive proper attention. The cause, particularly, should be investigated, as the condition is probably a progressive one. Lack of attention will result in irreparable damage to the cylinders and pistons, whereas if the scoring is detected early enough, it may often be removed by honing with a minimum of effort and expense.

The main causes for failures of fastening devices were found to be: wear, improper repair, improper adjustment and material defects. Improper repairs included the use of undersize cotter keys, worn or overstressed bolts and nuts, improperly fitted keys, and the reuse of cotter keys or "one time" lock nuts and lock washers. It may appear economical to reuse such devices, but it is false economy.

In some failures, the causes were found to have started with improper adjustment. Loose fastening devices allowed excess play, while those which were too tight became overstressed. These conditions are easily prevented.

In only a few cases were failures of fastening devices found to have been caused by material defects. Nevertheless, any such part to be used in the repair or reassembly of a compressor should be checked for defects.

The jacket cooling water spaces should be thoroughly cleaned. In some areas where the cooling water contains hard scale-forming materials it may be necessary to acid-clean the water jackets at intervals under competent supervision. If the compressor is so located as to be subjected to subfreezing temperatures during the idle period, then the jacket cooling water spaces must be either thoroughly drained or filled with a suitable anti-freeze solution to prevent serious damage to the water jackets and cylinders.

Centrifugal Pumps

Generally the centrifugal pumps that may be used to circulate chilled water and cooling water are of simple and rather rugged construction, requiring a minimum of maintenance. If the bearings and packing gland and the alignment between the pump and the driving motor are adequately maintained, then disassembly for inspection and overhaul is normally not required until unsatisfactory operating conditions are noted.

Fans

The fans should be thoroughly cleaned and carefully inspected for cracked blades, worn bearings and other defects.

Poultry Industries Conference Set

»» THE dates of February 10, 11, and 12, 1961, have been set for the 32nd Annual Fact Finding Conference sponsored by the Institute of American Poultry Industries.

Harold M. Williams, IAPI president, said the three-day session for poultry and egg processors and marketing organizations, would return to the Municipal Auditorium in Kansas City, Missouri—site of the Conference since 1946. Nearly 4,000 executives and managers will attend.

Scheduled to run concurrently with the Conference for businessmen is the 8th Junior Poultry & Egg Fact Finding Conference. This event for teen-agers is sponsored jointly by: The Cooperative Extension Service, Office of Education, Vocational Agricultural Branch; the National Committee on Boys and Girls Club Work, and the Institute of American Poultry Industries.

By M. L. HOGLUND
The Trane Co. LaCrosse, Wis.

Centrifugal

Continued From

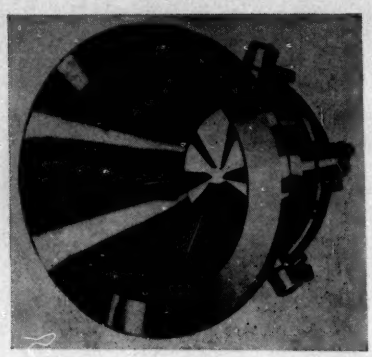

Fig. 10 — Prerotation vane assembly

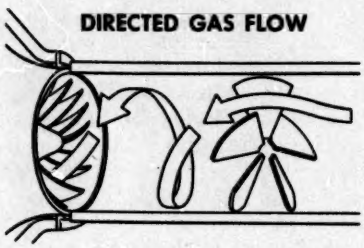

Fig. 11

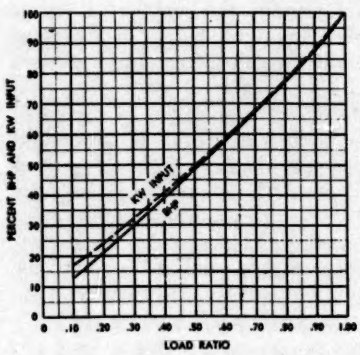

Fig. 12 — Power required equals cooling required

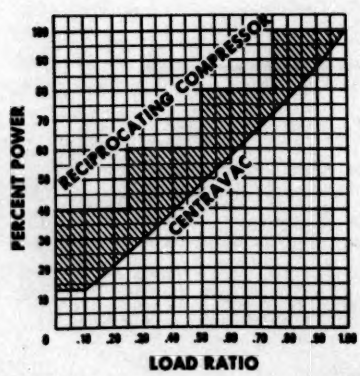

Fig. 13 — Centrifugal versus reciprocating compressor power consumption

The prerotation vane assembly shown in Fig. 10 is located ahead of each stage of compression, so there are two assemblies of this kind in each machine.

The vane housing is machined on the inside to insure smooth gas flow and is of the venturi shape to provide a good entrance condition into the impeller.

The pie-shaped vanes that make up the assembly are made of stainless steel and are mounted on stainless steel shafts. The vanes are positioned through a lever mechanism that moves the actuator ring, causing the blades to turn and spin the gas in the direction of rotation of the impeller. The actuator ring is mounted on stainless steel ball bearings, and the ball joint linkages that transmit the force from the ring to the vane shaft are cadmium plated so that there will be no corrosion and there will not have to be any lubrication.

At full load condition these vanes will be normal to the gas flow, and as the capacity requirement falls off, they will move towards the fully closed position where they completely block the gas flow. In the intermediate positions as mentioned, they spin the gas in the direction of rotation of the impeller, which imparts gas force to the rotating impeller and reduces the horsepower requirement of it. It is through the use of these prerotation vane assemblies ahead of each compressor that we get the wide capacity range, 10 to 100%, and the efficient part load performance that characterizes the centrifugal.

The use of prerotation vanes ahead of each compression stage is the only method that we know of that will give the wide range of capacity, 10 to 100%, with brake horsepowers varying from 13 to 100%, all under automatic control without any manual attention.

Fig. 11 shows the impeller at the left and the prerotation vane assembly at the right. They have been separated so that you can see the artist's conception of the spin given to the gas flow by the prerotation vane assembly.

Power Required Equals Cooling Required

In Fig. 12 we have load ratio plotted on the horizontal scale from 0 to 1, and the vertical scale shows percent brake horsepower and KW input. The solid curve is brake horsepower, and the dotted curve is KW.

As can be seen at point "A" which is 80% load, the horsepower is 77% and the KW input is 78%. At 50% load, the brake horsepower is 48% and the KW is 49%. At 20% load, the brake horsepower is 20% and the KW is 23%. At the minimum 10% load, the brake horsepower is 13% and the KW input is 18%.

This is not all. At the full load point, the machine invariably requires less horsepower per ton of output than do competitive machines. This, of course, is attributable to the over-all unit design and the care and time used in development of the impeller and volute housing. This outstanding performance is available without the use of an economizer, and on the units 200 hp and larger, an economizer is available as an optional item. The economizer can be used to give more capacity at a fixed horsepower, or less horsepower at a fixed capacity. The economizer will result in a 3 to 4% improvement in machine performance if it is necessary.

Comparing Reciprocating Compressor

In Fig. 13, the vertical scale is percent power. The horizontal scale is load ratio again. The CenTra-Vac part load curve is to the right below the step section shown in the chart. A reciprocating compressor curve for either a 4 or an 8-cylinder machine that has four steps of unloading from full load

Refrigeration Equipment

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to no load is also shown. The cross hatched area is power saved by the centrifugal compared with equal size reciprocating compressor.

Controls

The simplicity of the control that can be used with hermetic centrifugals has impressed engineers, architects and owners ever since these units were first introduced. This simplicity of control is the major reason why it is so easy to apply these units to completely automatic, unattended operation.

All hermetic centrifugal controls can be divided into two categories:

1. Operating controls.
2. Safety controls.

Safety controls or protective devices generally have no function during normal operation. They simply prevent the machine from operating under unfavorable conditions.

The primary safety controls are as follows:

1. Differential oil pressure controller.
2. Low temperature cutout.
3. High motor temperature cutout.
4. High pressure cutout.

It is important to protect the machine against a lubrication system failure. The differential oil pressure cutout switch stops the motor of the hermetic centrifugal if the net oil pressure drops below the preset minimum. It also prevents the machine from starting until full oil pressure is developed in the bearings.

The low refrigerant temperature cutout stops the motor before the evaporating temperature becomes low enough to freeze the water in the tubes of the evaporator.

With a water cooled motor, there could be a failure of the motor water jacket supply. The high motor temperature cutout stops the machine in the event of overheating of the motor due to this type of failure.

The high condensing pressure cutout stops the machine in the event of too high a condensing pressure. This may be caused by improper maintenance, causing fouling of the condenser tubes or it may be caused by a restriction in the flow of condenser water or even a failure of the condenser water pump.

In the Trane unit, the low temperature cutout, the motor temperature cutout and the high pressure cutout are connected in a lockout circuit. If the machine is stopped by any one of these controls, the reset button in the instrument panel cover must be pushed before the machine can be restarted. The differential oil pressure cutout is not connected in this lockout circuit. If oil pressure is restored to the bearings after a shutdown because of low oil pressure, the machine will automatically resume operation.

These safety controls are important and are required by all centrifugal refrigeration machines.

All the controls are assembled together and mounted in a panel Fig. 14.

In addition to the safety controls which are located at the bottom inside the panel, there is a load limit relay shown in the upper righthand corner and gauges for the evaporator, the condenser, lubrication system and the purge system. These panels are prewired and tested at the factory.

The operating controls are those which respond to changing cooling loads. Their primary function is to balance the machine capacity with the cooling demand.

Fig. 14 — Control panel

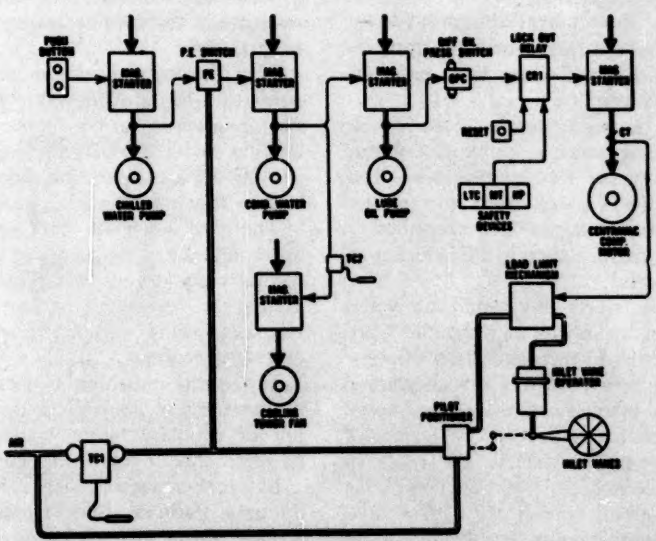


Fig. 15 — Trane centrifugal control system

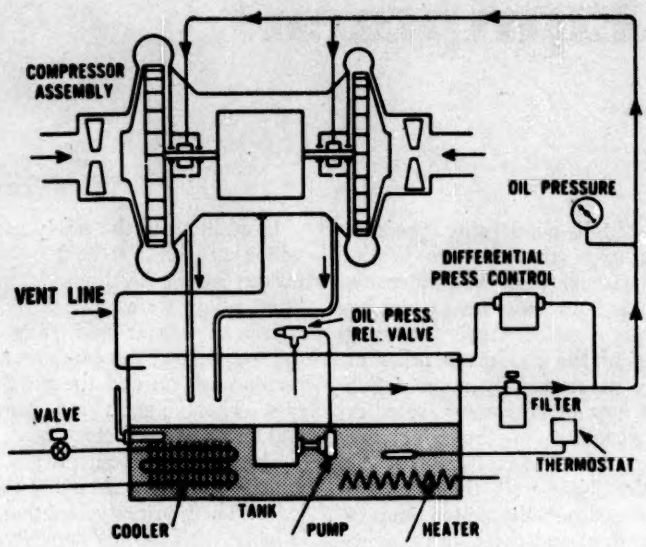


Fig. 16 — Lubrication system

The principal operating controls shown in Fig. 15, are:

1. Chilled water thermostat, indicated as TC1 in this diagram.
2. Pressure electric switch designated as PE in the diagram.
3. Pilot positioner.
4. Pneumatic vane operator.

Assuming that the machine has been properly installed, evacuated and charged, its operation can be entirely automatic. It is only necessary to start the machine by means of a push-button control. This is shown on the left of the diagram. Once it is started it will maintain the required temperature of chilled water from 100% down to 10% capacity.

As the control diagram shows, all that is necessary to start the chilled water pump is to press the start button.

If the water temperature leaving the evaporator is above the control setting on the temperature controller TC, air from the chilled water thermostat TC is applied to the pressure switch, PE, closing its contacts.

This starts the condenser water pump by means of magnetic starter which in turn energizes the time delay relay. After a predetermined time interval, the cooling tower fan motor will start by means of its magnetic starter. An interlock in this magnetic starter completes the circuit which starts the lube oil pump motor by means of its magnetic starter.

When the tube oil pump has established oil pressure to the bearings, the contacts of the differential pressure controller are closed.

Since the liquid refrigerant temperature in the evaporator is above the setting of the low temperature controller, its contacts will be closed and the circuit will be completed through the contacts of the lockout relay. This relay must be locked in the circuit by pushing the reset button when the system is first started, or in case either the high pressure controller or the motor temperature controller has dropped a lockout relay out of the circuit.

When the lockout relay has been energized, the circuit is complete to the starter.

This interlocking arrangement assures that the chilled water pump, the condenser water pump, the cooling tower fan and the lube oil system all are operating normally before the machine can start.

The unit will not start or will automatically stop when any of the auxiliary equipment fails. Thus, the system is protected against mechanical failure and improper operating procedure.

When the machine is running, the problem of controlling the output or capacity to meet the load requirements comes into play.

In order to accomplish load reduction, variable inlet vanes are located ahead of each stage of the compressor. These vanes are operated by means of a pneumatic motor controlled by the temperature controller TC located in the chilled water line leaving the machine.

As the temperature of the chilled water falls indicating a smaller load, the air pressure from the temperature controller is reduced, thus, causing the damper motor to start closing the inlet vanes and reducing the capacity of the machine.

When the temperature of the chilled water rises, indicating an increase in load, the air pressure from the temperature controller is again increased, causing the inlet vanes to open and increase the capacity.

To prevent overload on the motor when starting up or when cooling loads become abnormal, the extent of the vane opening is limited by a load limit control actuated by the amount of current which the motor is using. This load limit control restricts the amount of air pressure applied to the vane control motor when the motor current is excessive.

The load limit control is set to permit 105% rated current at maximum load.

As soon as the load condition becomes normal again, the temperature controller takes over to control the machine output.

Lube Oil System

The positive lubrication system is shown in Fig. 16. Only two sleeve bearings requiring lubrication, are needed to support the one major moving part, the rotor-impeller assembly.

With this carefully planned system the machine will not start, let alone operate, until full oil pressure is developed in both bearings. This is doubly important since practically all bearing wear occurs between the time that rotation begins and the moment lubrication is established.

The heart of the lubrication system is located in the base of the compressor assembly. Within the tank, immersed in oil, is a positive displacement gear type pump driven by an electric motor. This location prevents lubrication failure and vapor lock at the suction to the pump.

The pump takes the oil from the tank and discharges it into the pipe lines leading to the oil pressure relief valve and oil filter. The valve maintains proper pressure continuously by permitting some oil to bypass the system and return to the tank. The remaining oil is filtered and delivered at proper pressure to the two cartridge type sleeve bearings.

The oil pressure control, a safety device, measures the net or effective oil pressure at the bearings and is interlocked into the entire control system. It will not permit the compressor motor to start until the required oil pressure is built up at the bearings. Should oil pressure fail or drop below minimum pressure, the control will stop the compressor and start it when adequate pressure has been restored.

The oil temperature control system consists of a two-stage thermostat, an electric resistor type heater element, an oil cooling coil and a solenoid valve. This arrangement makes it possible to maintain optimum oil temperature at all times, for perfect lubrication and to prevent foaming on start-up.

The Purge System

The purge system is a unit designed to remove a purge from the refrigerant cycle, any gasses or vapors which are not refrigerant. In particular, the purge system must remove any air which might leak into the system without removing any of the refrigerant. You want the refrigerant to stay in the machine as it costs approximately one dollar per pound to replace it.

Fig. 17 shows the inside of the purge unit. The small 2-cylinder reciprocating compressor on the left side is driven with a belt by a single phase electric motor. In front of the oil separator with its electric heater are the thermostat and a discharge pressure safety switch which cuts off the purge compressor if the relief valve becomes jammed and the pressure builds up too high. There are two solenoid valves. The one on the right in the inlet line from the condenser to the purge compressor and the one on the left in the return line between the purge drum and the evaporator. The purge

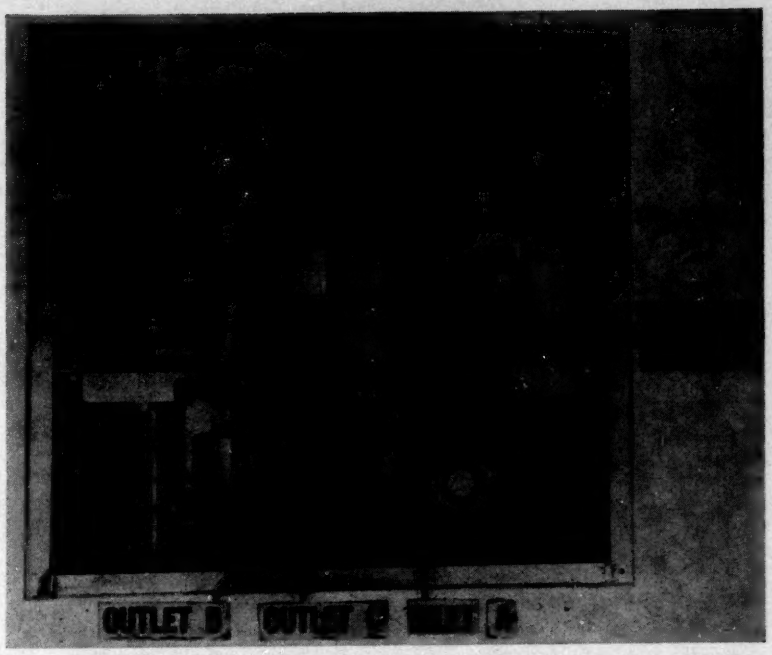


Fig. 17 — The purge system powered by a reciprocating compressor and motor

drum is mounted behind the two solenoid valves and has a sight glass for observing the presence of water on the refrigerant and a manual blow-off valve for draining off the water.

To determine when to run the purge system, read the condenser pressure gauge Fig. 18 and take a thermometer reading which indicates the condensing temperature while the centrifugal is running. Then plant the readings of these two instruments on a saturation pressure temperature chart for the refrigerant used in the machine. If the point falls above the curve, it means there is some air or noncondensibles in the condenser and purging is necessary.

Then the purge system should be run manually for about a half a day or longer if necessary until the point representing the readings of the pressure gauge in the thermometer when parallel on the chart, fall right on the saturation curve or near to it.

Most operators use this procedure. They find that purge system needs to be run just about half a day per month and this is done

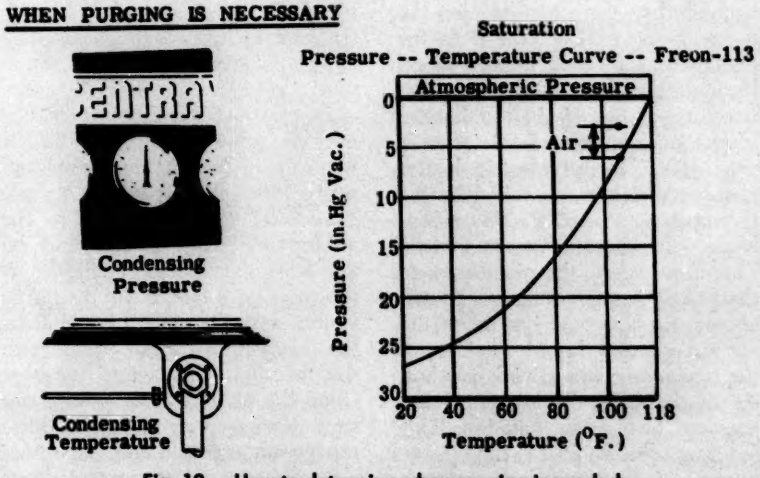


Fig. 18 — How to determine when purging is needed

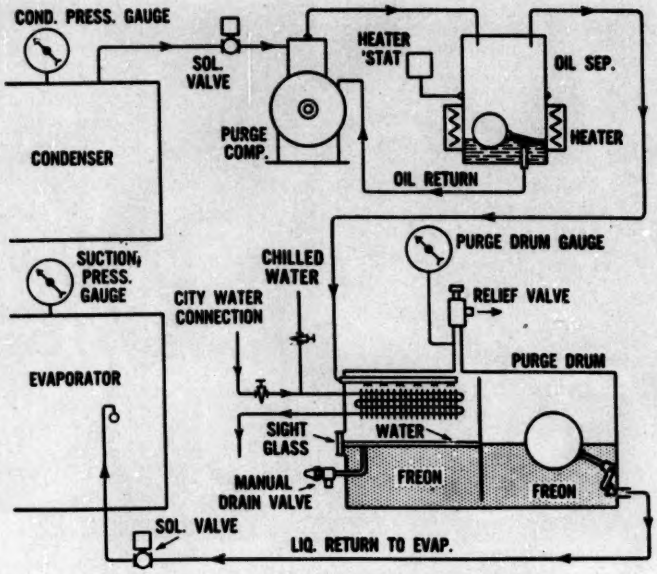


Fig. 19 — Schematic of the complete purge system

manually on a regular maintenance schedule. If you don't need to run the purge system automatically (that is, whenever the centrifugal runs in) it is best not to run it that way. Just run the purge system manually as often as is necessary to keep the condensing point right on the saturation curve. If this procedure is followed, the machine should always operate at peak efficiency.

When the purge system is started, both solenoid valves, see Fig. 19, open and the purge pump starts. The purge pump withdraws a mixture of air and refrigerant from the top of the condenser, compresses the mixture, and discharges it to the oil separator. The oil separator removes the oil entrained by the mixture in the purge pump and returns it to the crankcase of the purge pump through the float valve. The temperature of the oil in the bottom of the oil separator is maintained near 160°F by an electric heater element which is controlled by the thermostat. At 160°F, the refrigerant will not condense in the oil. Therefore, when the oil returns to the purge pump crankcase, it will contain no liquid refrigerant. If the oil did contain liquid refrigerant, the refrigerant would violently boil out of the oil at the low crankcase pressure and cause foaming. This foaming could cause the purge pump to temporarily lose so much oil that the purge pump bearing surfaces would fail because of improper lubrication, but the oil heater prevents this foaming and the possibility of purge pump failure.

The mixture of air and refrigerant enters the purge drum and diffuses over a finned coil. Chilled water from the evaporator flows through this coil and back to the evaporator when the chilled water pump is running. The chilled water keeps the coil and fins cold enough to condense about 90% of the refrigerant as well as much of the water vapor in the mixture. If purging is desired when the cooling system is *not* operating, the manual valve in the chilled water line is closed and the manual valve in a line connected to the city water supply is opened. The city water then flows through the coil and is wasted through a drain valve, not shown on this diagram.

However, 65°F city water can only condense about 80% of the refrigerant in the mixture of air and refrigerant. Any refrigerant not condensed will be vented to the atmosphere with the air and be lost from the system. Therefore, it is always desirable to run the purge system with the chilled water from the evaporator rather than with the warmer city water (except when the chilled water pumps are shut down) so as to lose as little refrigerant as possible.

The condensed refrigerant drops to the bottom of the purge drum. The condensed water is lighter than Refrigerant-113 and does not mix with the refrigerant so it floats on top of the refrigerant in the end of the drum to the left of the baffle plate. This sight glass in the end of the drum permits the operator to see when some water has accumulated. Then periodically he can bleed off the water by cracking the manual drain valve. It is important to keep this valve always tightly closed except when water is being bled from the drum.

As the depth of the refrigerant increases, the float valve in the right hand end of the purge drum opens slightly. The pressure in the purge drum is always considerably higher than the pressure in the evaporator. This pressure difference forces the liquid refrigerant through the float valve, the return line, and the solenoid liquid valve back into the evaporator of the centrifugal machine.

The air and other gases which were not condensed by the cooling coil accumulate in this space above the liquid refrigerant, and the pressure in the space gradually builds up. The purge drum pressure gauge which indicates the drum pressure is located in the instrument panel. This spring loaded pressure relief valve is set to open when the pressure beneath it reaches 12 psi above atmospheric pressure. Whenever the drum pressure reaches 12 psi, the relief valve opens and vents the air back to the atmosphere.

This type of equipment requires a minimum of attention in operation. From the maintenance standpoint, the purge system will require the most attention. This should be checked in accordance with the operation and maintenance manual.

Another thing that bears watching on any job is the condenser water system. Water treatment should be used on any condenser water system and it should be maintained. There will have to be a regular maintenance routine set up to keep the accumulation of mud out of the tower sump because if it is not kept out of the sump by periodic cleaning, this mud will get circulated through the condenser water piping system

into the condenser of the refrigeration machine and foul the tubes. When the condenser tubes are fouled, the machine does not operate at its maximum efficiency.

It may be necessary to clean the tower sump as often as every two weeks. Local conditions will determine the exact schedule. The water treatment should be checked approximately every month and renewed as required.

It is not necessary to change the oil in the lubrication system except at such times as it is a major overhaul of the machine which should not be any more frequent than every five years.

The line-up of 3-ton heat pumps atop Farah's.

Power lines in foreground brought up through roof.

Garment Maker Installs Heat Pumps

»» IN order to cope with El Paso's desert climate, effectively and economically, Farah Mfg. Company, garment makers specializing in work and play clothes, installed six 3-ton heat pumps, roof type, to air condition 4200 square feet of office area that houses some 50 employees.

"There are several problems involved in this installation", said Phil Barrett, Phil Barrett Refrigeration Company, El Paso, Texas. "First, there was the air borne lint arising from the materials and thread, almost invisible to the eye, which explains the reason for not utilizing heat pumps in the factory workrooms. To minimize the lint problem, the office had to be sealed off completely from the workrooms. The office of 4200 square feet, with 16 foot ceilings, has a total of 67,200 cubic feet. To make more of a problem, the office has a drop ceiling—egg crate type—five feet below the conventional ceiling. Within this five foot space, there is 1000 feet of fluorescent tubing for lighting the office. We are discharging the cold and warm air from the heat pumps above the egg crate ceiling. This not only makes a neater appearing installation, it provides for more practical maintenance, eliminating the necessity of taking down sections of the egg crate over the office machines and the heads of office employees. All maintenance is done atop the roof, including replacing the filters, located in the return air ducts."

For years, ever since El Paso has had a weather station, this has been a low humidity area, daytime average between 10 and 15 percent. For the past couple years the humidity has jumped, to as high as 50-60 percent, due to a switch in air flow that's now bringing in moist air from the West Coast and the Gulf of Mexico, obsoleting evaporative type cooling.

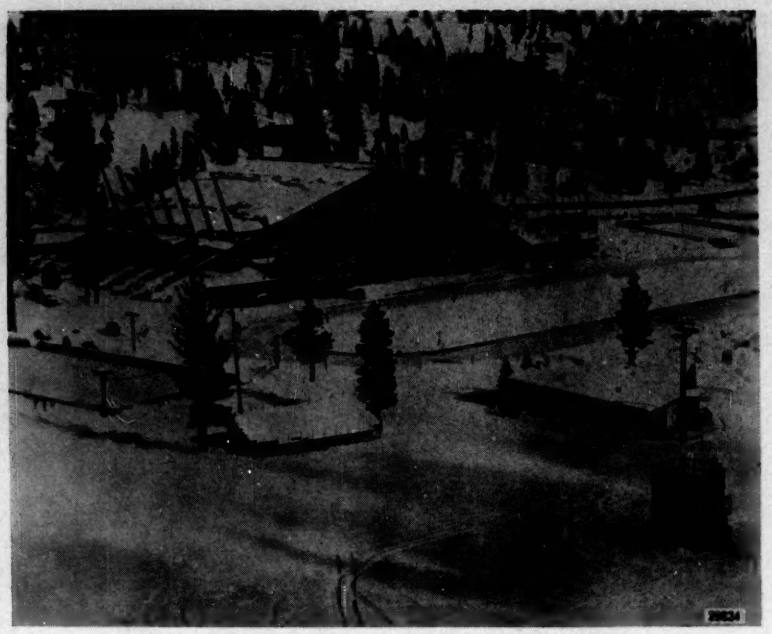
Phil Barrett installation contractor and Ben Hieken, El Paso Electric Company engineer, inspect a filter atop the block-long Farah Mfg. Building.

Heat pumps are also serving another problem for Farah. During the winter months it's not unusual for El Paso to have morning lows below freezing, and the daytime temperature climbing into the low 70's. Working automatically, during the night and mornings, the heat pumps are keeping the office at a pre-determined, satisfactory temperature. After the set temperature is reached, the heat pumps continue to circulate fresh, filtered air within the office area. As the outdoor temperature rises, the heat pumps cut in on the cooling action automatically, if required. The controlled temperature and the constant circulation of fresh, filtered air has eliminated employee fatigue and, hence, improved efficiency, stimulated better morale amongst the employees, and reduced costly errors to a minimum.

Until some means has been devised to eliminate the air-born lint, heat pumps cannot be utilized in the garment factories cutting or sewing rooms, it was explained. However, Farah's are so happy with heat pumps, they are climatizing a new warehouse with them.

Versatile 550 Ton Squaw Valley Heat Pump

Freezes Equivalent of Six Skating Rinks, Heats Arena and Performs Several Other Chores Simultaneously



The 8,000 seat ice arena at Squaw Valley with its four skating rinks, representing the largest area of artificially frozen rinks in the world. One heat pump supplies refrigeration for the rinks and heat for the arena and water heating.

»» AMERICAN refrigeration ingenuity—in the form of a heat pump built by the York Division of Borg-Warner Corporation—has provided the largest expanse of man-made ice ever frozen and made it possible to conduct the 1960 Winter Olympic Games on artificial ice for the first time.

In addition to supplying the equivalent of six standard size hockey rinks in ice pad area, the Olympic heat pump at Squaw Valley, California, will also keep a yearly average of 450 inches of snow from piling up on the roof of the 8,000 seat arena and provide both spectator heating and domestic hot water.

The ice areas consist of two standard hockey-size practice rinks, a 440 meter oval speed skating rink large enough to reach around a football field, and the beautiful $3,500,000 semi-enclosed arena.

The story of the selection and design of the heat pump for this "glamour" installation is typical of the progress that is being made in the application of these highly efficient systems.

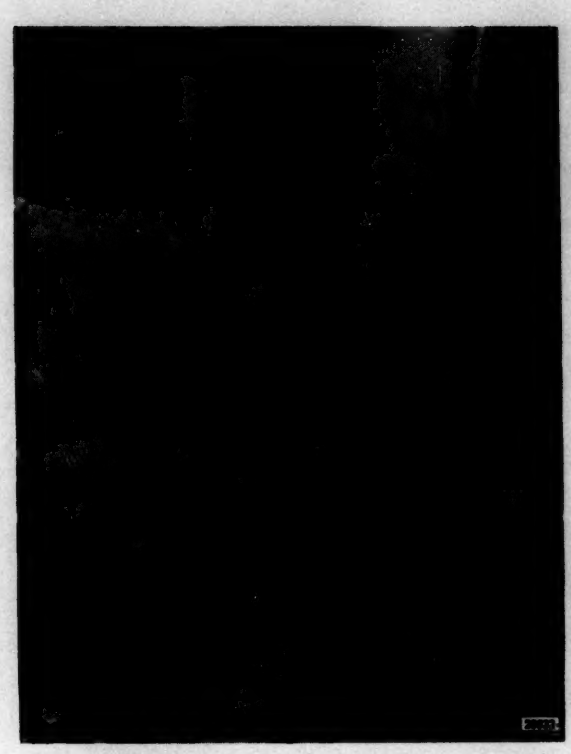
Cost A Prime Factor

After allowing for diversity, the consulting engineers, Vanament & Darmsted of San Francisco, established the load at 555 tons when cooling 550 gpm of calcium chloride brine to 14 degrees Fahrenheit. The problem then was to determine whether a central brine cooling system, or four individual brine cooling systems for the four individual rinks, would be the most advantageous. The prime consideration in this decision was first cost.

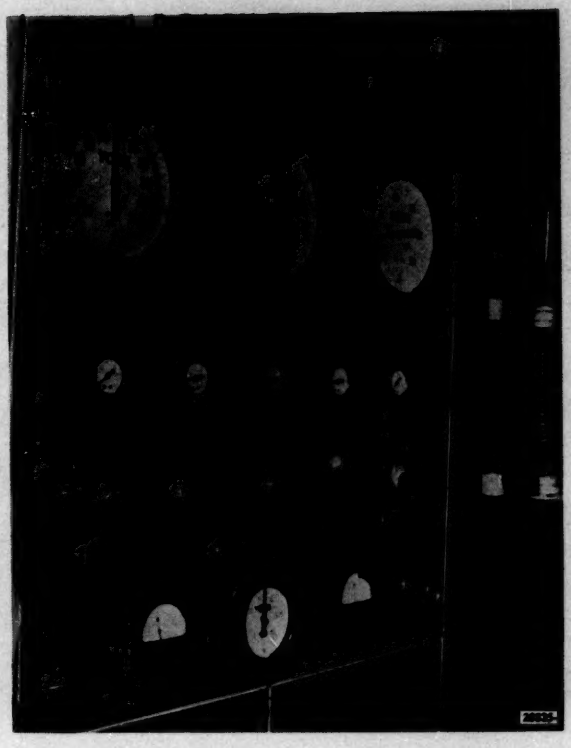
Highly detailed analysis based on almost complete design of the two approaches was made. In this analysis, a single centrifugal brine cooling system with main brine pump, 3-way valves and recirculating pumps at each rink was weighed against individual reciprocating packaged brine coolers at each of the rink locations. The results of the estimate heavily favored the central system and it was selected.

The next problem facing the consulting engineer was that of heating the arena. It had been established that heat would be provided for the lobby area of the arena, and the office and dressing room section of the arena building, as well as the necessary domestic hot water. In addition to this, a certain amount of heat was to be provided for thawing snow on the roof of the arena.

The purpose of this roof heating was not so much to melt the snow as it was to thaw a thin film of snow adjacent to the steel roof deck to facilitate sliding of the snow off of the roof into the snow melting pits at the sides of the building. A small amount of heat was allocated for arena spectator area heating sufficient to keep the arena at approximately 50°, at peak heating load conditions and higher, when the heating load did



The high-stage York Turbomaster three-stage centrifugal compressor for the heat pump. Driven by a 1,000 hp motor, the compressor cools the brine to refrigerate the ice skating rinks, and discharges into the condensers. Heat from condensers is used to heat spectator areas.



One of the panel boards for the York Heat Pump at Squaw Valley. This indicates operating pressures and has controls for manual adjustment of compressor capacity supplementing the fully-automatic controls. Push button starters for compressors are at bottom.

not peak and snow thawing was not required.

Approach to the heating system was a conventional oil fired steam heating arrangement until the consulting engineer conceived of the idea of using the brine cooling system condenser heat rejection to assist in the heating of the arena. Such an arrangement would reduce operating cost considerably but would not reduce first cost significantly. This is true since peak heating loads would occur frequently, but not always, at a time when the brine cooling load would be minimum or zero.

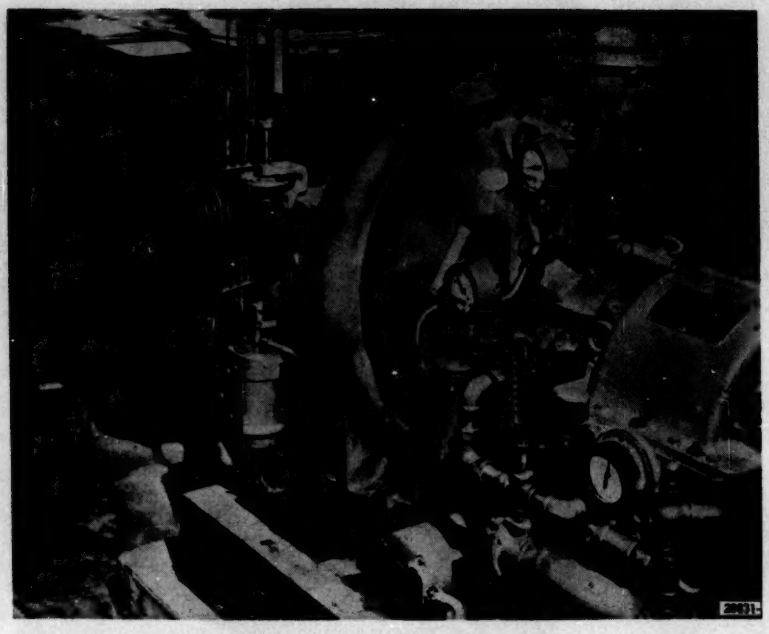
With the idea of heat pump approach thus put forth, an investigation was entered into the possibility of superimposing a York compound air source heat pump, using the brine cooling system as the basic building block. Such a system, however, would have to meet two requirements. First, the outside air heat source evaporators would have to be located over 300 feet from the building in order to preserve the architectural unity of the arena. Second, the first cost would have to be equal or lower than the conventional oil fired steam heating system, regardless of any savings in operating cost.

Made Savings Possible

Such a system was designed and adequately met the requirements. But, in addition to this, due to the considerably increased energy consumption and relatively low increase in demand, the power company agreed to provide the primary distribution in the Valley itself at a saving to the California Olympic Commission in the neighborhood of one-third the value of the heat pump system. This was in addition to other savings on the elimination of multiple equipment and reduced construction costs.

The heat pump system that finally emerged is a simple one. A long and narrow equipment room is provided for the refrigerating equipment at slightly below grade. Below the concrete floor of the equipment room, the main concrete brine storage tank is located and in a walled off portion of this tank, space is provided for the main refrigerant operating receiver. Vertical turbine brine pumps extend from the machine room floor into the brine tank and pump directly into the brine chiller and then out to the rink areas.

The refrigeration equipment room is of sufficient size to house the main brine pumps, brine chiller, booster compressor, auxiliary heating devices and electrical control equipment. Directly over one end of the equipment room and two floors above it, is located the first of two approximately equal size fan rooms in which the heating coils are located. The other fan room is located at the same elevation, but some 60 feet beyond the opposite end of the equipment room. The outside air evaporators,



The low-stage cycle single-stage centrifugal compressor driven by a 200 hp motor. This compressor takes suction from the outdoor air units and operates when sufficient heat cannot be taken from the brine cooling system.

as previously mentioned, are some 300 feet external to the equipment room.

To trace the operation of the system, it is most convenient to start at the discharge flange of the brine cooling or high stage compressor which, incidentally, is a 3 stage compressor driven by a 1,000 hp. induction motor. Now, assuming wintertime condition and full load design heating requirement of 4-1/2 million Btu per hour, the hot discharge gas flows from the compressor to the heating coils in the fan rooms. These coils are very similar to steam coils with certain modifications to function with the condensing refrigerant instead of steam. Temperature control is achieved by face and bypass dampers as the system control will automatically provide 110° condensing temperature.

The liquid is trapped as it leaves the coil in a fashion similar to treatment of a steam coil, and the condensed liquid is then returned to the operating receiver in the brine tank area. High pressure float drainers are used for trapping the coils and due to the low latent heat of Refrigerant 12, as compared to steam, these traps are quite large as are the refrigerant vapor and liquid lines. A suction line is taken off the main operating receiver and enters the high stage compressor through a bleeder port at the suction to the third stage, thus maintaining a pressure in the receiver considerably below condensing pressure in order to insure efficient operation of the float drainers and rapid draining of the return line to the receiver.

Liquid from the main operating receiver splits into two streams, one going to the main brine cooler and the other going to the outside air source evaporator. The outside air source evaporator is composed of a number of standard coil sections which are fed by means of pump recirculation from a generously sized pump receiver. Liquid from the main operating receiver enters the pump receiver through a liquid level control valve. Liquid is picked up from the bottom of the pump receiver by means of a centrifugal pump and circulated through the coils of the evaporator and back to the pump receiver. Suction is taken off the top of the pump receiver and returned to the equipment room where it enters a single stage 200 hp. centrifugal compressor.

Under full load heating design conditions, it would enter the compressor at approximately minus 30° saturated suction temperature with some superheat. It is discharged into the brine cooler below the liquid level so that the brine cooler acts to desuperheat the discharge gas from a booster compressor. Saturated gas then leaves the brine cooler and enters the high stage compressor to be compressed to a pressure corresponding to 110° and thus completes the cycle.

Bypass To Air Coolers

Valve bypass line is provided around the booster compressor so that the high stage compressor may operate directly off of the outside air coolers. It is apparent then that the high stage compressor will satisfy the heating requirement whenever there is sufficient brine cooling required and/or whenever the outside air dry bulb is within 15° to 20° above the lowest saturated suction temperature that the 3 stage brine cooling compressor can develop under the brine cooling requirement at that particular time. This condition will prevail for over two-thirds of the total heating hours.

When this condition is exceeded either by an increase in heating demand or a falling outside dry bulb, the booster compressor is put on the line to lower the outside air evaporator temperature and thus provide the extra necessary heat required at the heating coils.

In the event of rink pull-down when maximum brine cooling loads occur, and less than maximum heating is required, and also in the case of summer time operation, the high stage compressor discharges into the outside air evaporator which then acts as an air cooled condenser on the reverse cycle. Liquid then is drained from the outside air cooling coils, now acting as condensers, into the pump receiver which now acts as the main operating receiver. Transfer lines and valves are provided to keep the Refrigerant-12 charge in balance.

The main brine cooling compressor or high stage compressor has its prerotation vanes controlled by means of a suction pressure controller, sensing the pressure in the brine cooler. This controller is set

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For low temperature frozen food room—three Krack No. 36-ED Automatic Electric Defrost Units. 4,760 BTU/hr/1° TD capacity for each unit. Refrigerant: Flooded Ammonia. Type: ceiling.

For two cooler rooms—two Krack No. 5 floor type Industrial Product Coolers. 17,200 BTU/hr/1° TD and 21,300 CFM capacity for each unit.

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Five Krack Coolers were used. Three low temperature electric defrost ceiling coolers maintain −10° F. in the frozen food room; two floor units hold temperature at 36° F. in two dry storage rooms. Krack equipment was chosen by High-Low Foods' management because of dependable past performance. They have been a satisfied user of Krack equipment for 28 years.

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to maintain a pressure in the brine cooler sufficient to produce the desired leaving brine temperature. Thus it is seen the brine cooling compressor will produce the desired leaving brine temperature regardless of whether the booster is in operation or not. When the brine cooling load is greater than the heating load, the discharge temperature of the gas leaving the high stage compressor is controlled by varying the number of outside air evaporator coils in operation. This is done by means of a pressure controller with its sensing element in the discharge line maintaining 110° condensing temperature under full load design conditions. This controller operates a step controller which automatically brings on outside air cooler coil and fan combinations as the cooling load increases.

As the heating load increases in proportion to the cooling load, the outdoor air unit coils and fans progressively shut down to maintain the desired condensing temperature. When the heating load exceeds the cooling load, the outdoor air unit is changed over to serve as an evaporator which picks up heat by cooling outside air. Under this last condition, the booster compressor is put into operation at low outdoor temperatures, and the prerotation vanes of this compressor are automatically controlled to produce the desired condensing temperature. The condensing temperature can be varied with outdoor temperature to provide for the most economical operation.

Rapid Defrost Provided

The outside air evaporator coils are fabricated of 3/4″ spiral fin coil with fins on 3/8″ pitch, hot dip galvanized after fabrication. This type of surface holds a considerable amount of frost and greatly reduces the intervals of defrosting. Nevertheless, defrosting is an important part of successful operation of air source heat pumps and this is particularly true in the outside air dry bulb ranges of 30° to 15° where the frost build up can be quite rapid. The outside air heat source coils are provided with necessary control to achieve automatic water defrosting of the coils, coil bank by coil bank, as the static pressure across the coils increases to the point of inefficient operation. The coils are located above a concrete drain pan and tank which holds sufficient water for defrosting the coils in sequence.

A hot Refrigerant-12 gas water heating coil is provided to keep the temperature of the defrost water sufficiently high for efficient defrosting. A vane axial fan is provided for each coil bank and the coil banks are automatically isolated by means of turning off fans and closing refrigerant lines, so that they may be shut down independently both for defrosting and temperature control. The entire coil bank was field fabricated and provided with housing structures sufficient to handle the heavy snow load.

The refrigeration plant is also utilized to heat domestic hot water. The domestic hot water is heated to its desired temperature in two steps, the first being hot gas heating coil within the first stage heater which heats the water to around 105°. From this heater it goes to a direct electrical heater which carries it on up to the proper temperature for domestic hot water.

Snow Melting Pits

An independent ethylene glycol brine system is heated entirely by condensing refrigerant gas. Warm ethylene glycol from this system is circulated to heating coils beneath the insulation of the main brine storage tank below grade to prevent frost heaving of the surrounding soil. Ethylene glycol from this same system is also circulated to coils in the bottom of the snow melting pits along the side of the arena.

The cost of the complete refrigeration cycle, including heating coils and motor starters, but not electric wiring, was less than $600.00 a ton based on the brine cooling tonnage. The cost of the complete installation, including the rinks and the heating system was in the neighborhood of $1300.00 a ton.

Dramatic New Building Uses Marlo Air Conditioning Units

»» THE latest in a long list of architectural triumphs by Minoru Yamasaki is Reynolds Metals Company's new Great Lakes Region Headquarters Building in Detroit.

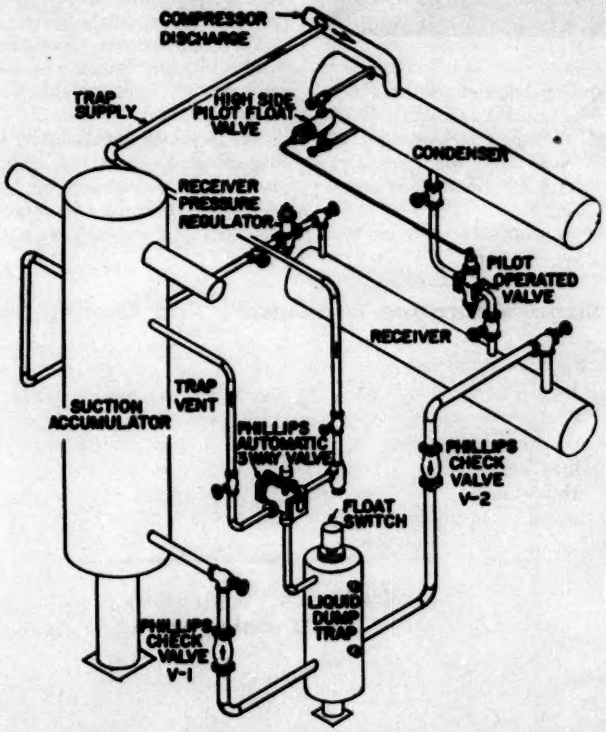
The three-story, $2,000,000 structure is a living demonstration of the versatility of aluminum as both a structural material and as a medium of artistic expression. Its practical applications range from the dramatic exterior gold anodized sun screen to interior office furniture.

A winter-summer climate control system provides round-the-calendar comfort for employees and visitors in this superbly-designed building. Marlo spray type dehumidifiers and central station unit perform important functions in the perfectly balanced air conditioning system.

General contractor for the project was Darin & Armstrong; Consulting engineer, Charles Whitney; interior decorator, W. B. Ford Design Associates; Landscaping, Eichstedt Johnston Associates; electrical contractor, Shaw Electric Company.

New Products Designed to Improve Operation

Ammonia Circulating System



A CENTRALIZED ammonia circulation system, to achieve a semi-flooded liquid control in direct expansion coils without the use of pumps, has been introduced by H. A. Phillips & Co., Chicago. It produces a constant pressure plant feed with circulation rates up to three times the evaporation rate, and is adaptable to existing plants as well as to new construction.

It combines the benefits of better heat transfer and simplified piping for evaporator control and defrosting with protection to the compressors. It avoids the maintenance problem associated with rotating seals and bearings.

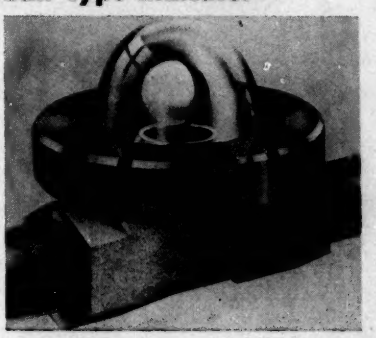
Several arrangements have been developed and tested for single stage and multiple stage plants. Coil heat exchangers may be added to the accumulators to improve the performance by reducing flash gas and reducing the liquid return quantities.

Simple orifices or balancing valves may be used to meter the liquid to individual evaporators, or circuits.

Conventional float valves and thermostatic expansion valves may be retained since the liquid feed pressure can be adjusted to the plant conditions so as to provide sufficient liquid head to insure fully wetted coils.

For more information, write for Bulletin LCS-60, H. A. Phillips & Co., 3255 W. Carroll Ave., Chicago, Ill.

Ball Type Indicator



FOR flows down to 0.075 gpm (water) and 1/2 cfm (air or gas), this simple, reliable indicator shows at a glance whether flow is taking place.

Clearly visible from a distance, even in bad light, the flow makes the ball dance in the toughened glass dome. If the flow stops, the ball drops out of sight.

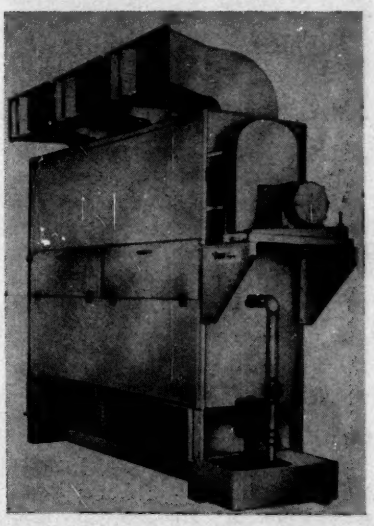
Useful in applications such as air, steam, water, and oil purge lines to instruments and mechanical seals; cooling water to compressors, condensers, jacketed process vessels, laboratory equipment, and electronic equipment; lubricating oil to bearings; and many others.

The new Arkon "Ball Type" Flow Indicator is made in 1/2" pipe size for pressures up to 100 psi. with die-cast bronze body, and either Nylon or Teflon ball. With only one moving part, there is nothing to go wrong.

This indicator, as well as other types and sizes of indicators up to 3", for flows up to 120 gpm., are available from McIntosh Equipment Corp.

Spray Coolers

AN improved line of floor type industrial refrigeration units which utilize a continuous liquid defrosting spray for lower temperature applications has been announced by Imeco



Incorporated, refrigeration equipment manufacturer, of Chicago, Illinois.

The new line has been completely redesigned and has been extended to include a range of sizes from 5000 cfm to 25,000 cfm with refrigeration capacities of from 3 to 24 tons. These units are designed to use brine or any suitable liquid as the defrosting medium

and are made for use with ammonia, Refrigerant 12 or brine as the refrigerant. They are available arranged for fully flooded operation, liquid recirculation, or thermal expansion valve operation.

A choice of either prime surface coils or finned coils with a selection of coil depths to meet almost any application requirement is available. Units are complete with centrifugal fan assembly, defrosting spray pump and motor, spray header and nozzles, sliding type removable eliminator section and full length access doors. They are designed for very rugged duty with fans, casing and tank section all hot dipped galvanized after fabrication.

Pipe-Fitting Insulation

MOLDED fiberglass insulation for standard pipe fittings is now available in four thicknesses: ½", 1", 1½" and 2". FIT•rite, a product of Fibrous Glass Products, Inc. a subsidiary of Pall Corporation, comes in standard

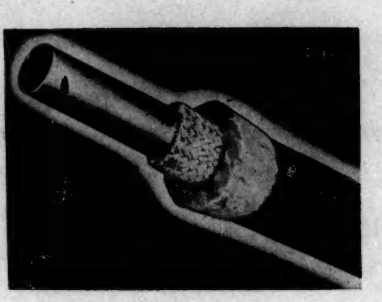
sizes for welded and cast ells, tees, and upon request, for special shapes.

Each fitting comes in two accurately molded halves which fit together instantly. It is easily installed with staples, soft wire or tape; once in place it can be finished with canvas or vapor barrier casings and the job is done.

All standard pipe-fitting insulation is available for immediate shipment.

Slip-On Insulation

UNARCO Insutube, manufactured by Union Asbestos & Rubber Company, Fibrous Products Division, Bloomington, Illinois, is a light-weight, non-combustible flexible tubing designed for temperatures ranging from 50° up to 500°F. It is used for insulating bent piping or tubing, where the use of rigid material is impractical. It is also recommended for insulating flexible connecting lines and for conditions of severe vibration.



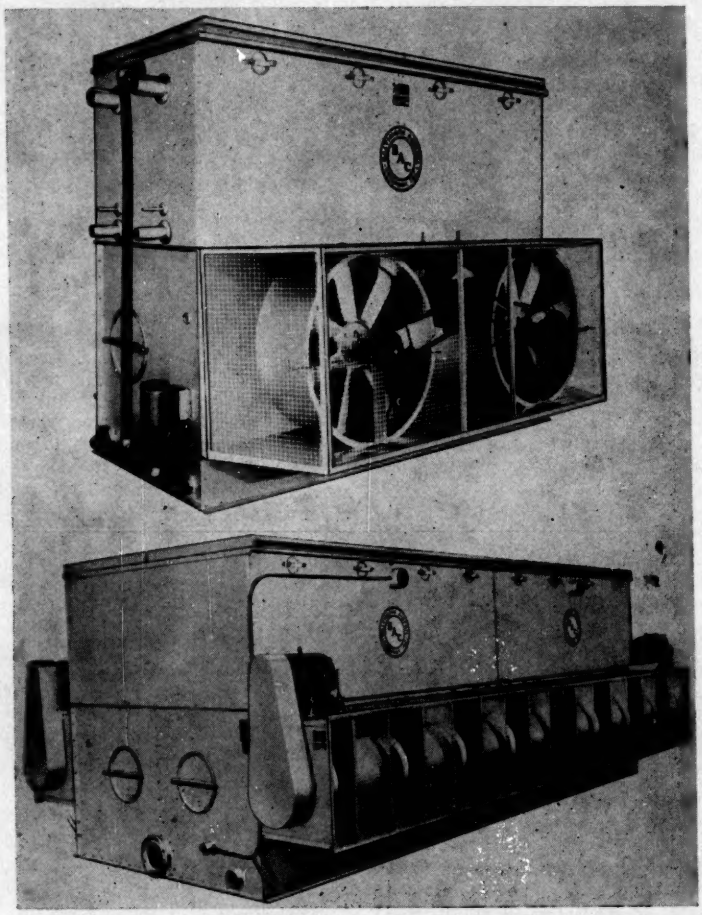
The product consists of three basic parts—a braided asbestos inner tubing; an extremely light-weight fibrous-glass insulation; and an outer covering jacket of braided asbestos tubing.

Insutube is available with an uncoated outer jacket or with an outer jacket coated with an oil and abrasion resistant self-extinguishing synthetic rubber. A heat-sealed plastic liner vapor barrier inserted between the outer jacket and the fibrous glass insulating medium is available if desired. This coating material can be supplied in a self-extinguishing type. The asbestos and fibrous glass components are non-combustible.

The manufacturer recommends Insutube for applications requiring low conductivity, light weight, flexibility, and fire-safety.

The product is available in tube sizes ranging from 1/4 inch up to one inch in increments of 1/8 inch, and also in 1½ inch and 2 inch sizes. All tubes are one-half inch thick.

Large Size Evaporative Condensers And Cooling Towers



EVAPORATIVE condensers and cooling towers, manufactured by Baltimore Aircoil Co., Inc. are now available up to 700 tons in single, factory-assembled units. This is the first time in the history of the industry that factory-assembled units of this large size have been offered as a standard line instead of custom made.

Three models of both cooling towers and evaporative condensers are offered to cover every refrigeration and air conditioning application. Blow-thru and draw-thru units with slow-speed, quiet-operating centrifugal fans are available as well as blow-

thru models with highly efficient tube-axial fans.

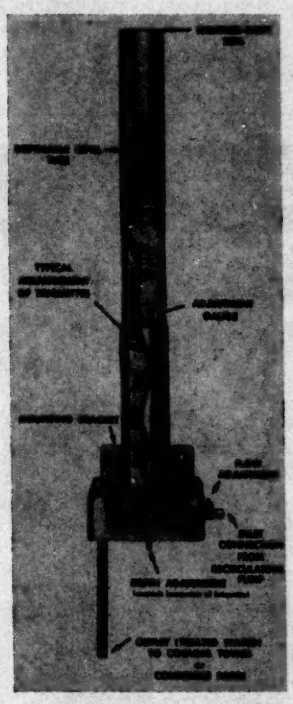
Suitable for either indoor or outdoor installation, blow-thru models up to 100 tons are also the first units offered with connection flanges for ductwork on the air inlets as well as outlets.

All units are constructed entirely of heavy-gauge steel, hot-dip galvanized, and all surfaces inside and out are further protected from corrosion by a coat of B.A.C.'s Zinc-Chromatized Aluminum Finish.

Units up to 100 tons are now available from stock while larger sizes are now available on the regular production cycle.

Chemical Control For Cooling Towers

THE Chemicator, a new concept for feeding balanced chemical treatment into circulating water systems of cooling towers and evaporative condensers, has just been placed in national distribution by the manufacturer, Erlen Prodcts Company, Burbank, Calif.



The Chemicator is a small, lightweight, closed reservoir, mounted on the side of the equipment, through which a portion of the recirculating water flows. On the upper portion of the Chemicator a sleeve holds a weather-sealed plastic tube containing a sequence of variously formulated compressed chemical briquettes. These are made of polyphosphates and organic chelates to remove and prevent the formulation of scale, organic corrosion inhibitors to remove and prevent the formulation of rust, together with automatic pH, algae and slime controls. As the briquettes are gravity-fed into the water flowing through the reservoir, they slowly dissolve and are carried into the entire system.

According to the manufacturer, the Chemicator has no moving parts yet feeds the proper chemicals in precise amounts automatically. The flow of the recirculating water controls the system. Chemicals are fed only when the pump is in operation, only when they are needed, at a pre-determined rate required for positive control.

The briquettes are packaged in many different combinations to combat practically every known water problem of any geographical area. Literature, prices, technical information and illustration data may be had by writing to Erlen Products Company, Burbank, Calif.

Cooling Coils

THE Trane Company, manufacturer of extended surface fin-and-tube coils for more than 45 years, has developed a new line of cooling coils

CHILLED BY HIGH FREEZING COSTS?

3521 CONTACT KOHLENBERGER!

You'll warm to industrial refrigeration economically designed and manufactured by Kohlenberger. Here's *complete* service covering every aspect of your refrigeration needs...from equipment manufacture and system design to plant layout and field erection. Since 1922 Kohlenberger Engineering Corporation has built its reputation on the skill of its engineers... the dependability of its equipment. We'd like to show you how you'll benefit. Write for literature or phone LAmbert 5-3521.

1. KMV Compressor: 20-200 HP. Heavy duty, high speed industrial refrigeration compressor units for ammonia and freon refrigerants.

2. KE Condenser: Heavy duty industrial evaporative condenser. 10-200 tons.

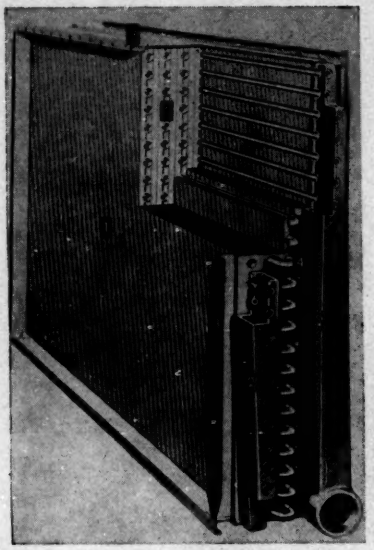
3. Krakice Maker: 10-60 ton ice capacity per unit. For every crushed ice requirement.

4. Unit Cooler: Industrial floor-type unit cooler for ammonia, freon and brine refrigerants. 5-30 tons.

Franchises available for qualified industrial refrigeration contractors. Contact C. R. Kohlenberger, president.

KOHLENBERGER ENGINEERING CORPORATION

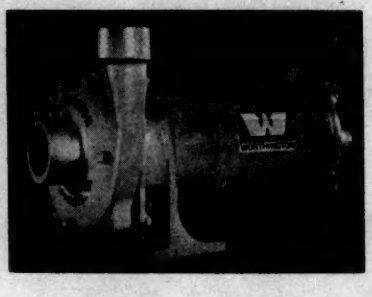
1600 COMMONWEALTH AVE., P.O. BOX 432, FULLERTON, CALIFORNIA



which have greater capacity per unit volume than previous coils. Trane has also developed a new method of cooling coil selection which is more accurate, yet more simple to use, than present methods.

The cooling coils feature a newly developed fin configuration called "Sigma-Flo" which increases heat transfer efficiency, a new casing design which reduces over-all coil dimensions, eliminates air bypass and minimizes moisture carry-over on the dehumidifying coil, and new streamlined cast iron headers. The new coils are available in several models, including standard water coils, cleanable and drainable water coils and direct expansion cooling coils.

Water Pumps



WORTHINGTON Corporation announces the introduction of an "Econobloc" line of pumps, designed for economical application in the air conditioning industry. The pumps, available in 6 sizes in the fractional horsepower range, deliver up to 80 gallons per minute and heads to 110 ft. They feature higher efficiencies, a reliable and easily replaceable mechanical seal used exclusively in the entire Econobloc line, and space-saving compactness of design.

Die cast aluminum bronze impellers with shell-molded casings insure smoother waterways, and on the smaller sizes, the mechanical seal can be serviced without disturbing either suction or discharge piping.

Above 1½ hp and up to 7½ hp, the Econobloc is built with the features of the Monobloc line which Worthington has had available for years.

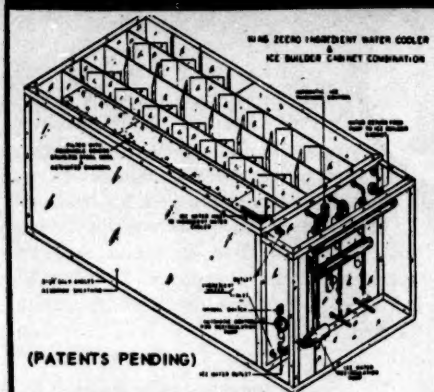
Spray-Can Solvent

A CHEMICAL solvent which is said to completely clean electrical motors and parts of oil, grease, dirt, dust and other materials is now available in convenient aerosol containers.

Called "Swish Elektrokleen", the solvent will also "demoisturize" equipment which has been short-circuited by water.

Unlike most aerosol sprays which are "mist-fine", Swish Elektrokleen utilizes a special nozzle which provides a long-range, concentrated drenching spray to flush off undesirable foreign materials.

For Ideal Filtered Ingredient Water at Low Cost



- Cools water 34 degrees Fahrenheit.
- Filter removes all silt, algae and chlorine from city or well water supply.
- Pure water is chilled by ice water -- *prevents freeze-ups.*
- The ideal water for ingredient and wash water applications -- food processing needs, butter or cheese wash, dough water, poultry or produce chilling.

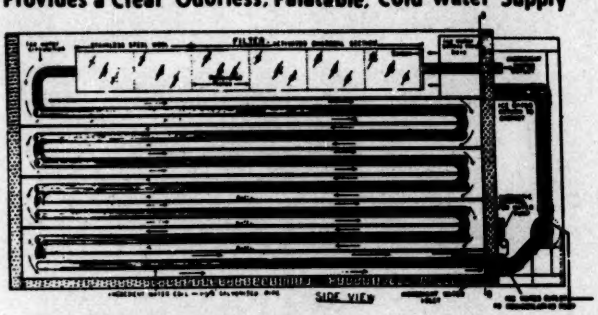
Available in Cabinet or Vertical Styles.

Write for Bulletin PWC 59.

Choose "King Zeero's" NEW

PURE WATER COOLER

Provides a Clear Odorless, Palatable, Cold Water Supply



The KING ZEERO Pure Water Cooler consists of a galvanized pipe water coil, a self contained efficient charcoal filter, a KING ZEERO Ice Builder and an ice water recirculation pump, with controls and necessary valves for flow and back wash, all contained in an integral unit

THE KING ZEERO COMPANY 4300-14 W Montrose Ave Chicago 41, Ill.

Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks Pure Water Coolers

Swish Elektrokleen will drain off and dry; in easily accessible areas it may be wiped off with cloth or absorbent paper. It is said to leave no residue to pick up dirt.

It is non-combustible, and will actually extinguish a flame if sprayed on it. It is further said to be non-toxic and non-corrosive–it will not stain or corrode metals and will not attack paint.

Swish Elektrokleen's properties make it ideal for cleaning such in-plant items as: motors, generators, commutators, slip-rings, contact breaker points, switch mechanisms, power tools, fans, ducts, oil burners, typewriters and office machines and removing oil and grease spots from floors.

Moncton N.B., Canada Has Refrigerated Warehouse

»» THE report in the December issue of *Industrial Refrigeration* that Moncton, New Brunswick, Canada was without refrigerated warehousing facilities and that the Mayor of the city was negotiating with private interests for such a facility was a reportorial error.

Moncton Cold and General Storage, Ltd. has provided such facilities for the past 21 years serving as a storage and distribution center for the Atlantic provinces.

Silencer Catalog

»» A BRAND new eight page color pamphlet has been published by Elof Hansson, Inc. Acoustical Division, 711 Third Avenue, New York 17, New York, listing all types of silencer products for air conditioning, heating and ventilating equipment. The literature gives dimensional data, certified sound attenuation and pressure drop. All silencer products are guaranteed and bonded. Literature will be sent free of charge upon request.

New Ucon Refrigerant Valve Has Hand Wheel

»» AN improved refrigerant cyinder valve that is hand-wheel operated is announced by Union Carbide Chemicals Company, Division of Union Carbide Corporation.

Reportedly a major design advancement in refrigerant packaging, the new valve will be used on all Ucon Refrigerant cylinders. It incorporates several proved features of the refrigerant valve now in universal service. In addition, two design improvements have been made to provide easier operation, to decrease maintenance, and prevent leakage.

For many years, refrigerant cylinders utilized a valve originally designed for chlorine service. The new valve, however, has been especially designed for fluorocarbon refrigerant use.

Another feature of the unit is its packless diaphragm design. Eliminated are the continual adjustments and

GET ACCURATE FLOODED SYSTEMS CONTROL

with this level regulator

A SIMPLE CONTROL IS THE BEST CONTROL

PHILLIPS FLOAT CONTROLS

- Proportioning action for smooth feed at all capacities
- Tight Closing with Teflon seat discs
- Self actuation—no electrical or pneumatic connections needed
- Visible liquid level through exclusive "Level Eyes"
- Adjustable level achieves maximum capacity with minimum charge

IN ADDITION — Phillips pilot operated valves are available for all common refrigerants, down to —50° F. Operates with as low as 2 PSI pressure drop and up to 250 PSI with selected springs. Line sizes ½ inch to 4 inches with steel or copper connections.

Solve your flooded system design and application jobs by consulting Phillips. Our firm of engineers have specialized in level control, liquid-vapor separation, liquid circulation and return systems for over 28 years.

H. A. PHILLIPS & CO.
Designers and Engineers
Refrigeration Control Systems
3255 W. Carroll Ave.
Chicago 24, Illinois

replacements of packing and the leakage problems commonly associated with the chlorine valve.

Those features of the old valve which have been retained include the use of naval brass as the structural material for the valve body and the use of Duronze alloy in the spindle. In addition, the positive safety feature of the fusible poured metal alloy plug has been retained.

Air Distribution Catalogs Announced By Anemostat

»» A NEW comprehensive set of air distribution catalogs, describing a wide range line of air diffusion equipment, is now available from the Anemostat Corporation of America.

The data has been published in eight separate catalogs for ease of reference. Each one contains complete application and performance data on a basic type of Anemostat unit. Included in these catalogs are dimension drawings and tables as well as cfm capacity, static pressure and radius of diffusion rating for every available diffuser size.

The catalogs are as follows: (1) Circular air diffusers, (2) Square air diffusers, (3) Straight Line air diffusers, (4) Perforated air diffusers, (5) Diffus-A-Plate, (6) Air diffuser accessories, (7) All-Air high velocity units, (8) Constant volume turbulators and LPL valves.

Copies of these catalogs may be obtained from Anemostat Corporation of America, 10 East 39th Street, New York 16, New York.

Recold Installs Air Handling Units For Headquarters Of Tidewater Oil

»» ALL of the air handling units in the new World Headquarters of the Tidewater Oil Company, located in Los Angeles, have been provided by Recold Corporation. This building is 340 feet long, and 10 stories high. The air conditioning features two Recold Multizone units on each of the first six floors of the building. One unit serves the East and one the West wing of each floor. The system is a chilled water, hot water system, with double duct construction. The hot and cold ducts, tapped off at each Multizone unit, run down each main corridor. Each individual zone of the building is tapped and controlled off of the hot and cold ducts.

Two additional Multizone units serve special areas of the building. The first air conditions the IBM room, and is controlled separately, so that it may be in operation 24 hours a day, without making it necessary for the entire system to be in operation for just one area. The second unit serves the mezzanine and storage rooms.

The exterior of the building features white marble, black granite and stainless steel spandrels. Electronic computers control the elevators in the building and automatically compensate for hour to hour variation in passenger traffic.

The Tidewater Oil Building is equipped with the most modern of communications methods, with a pneumatic tube system speeding inter-office communication. Private microwave radio connects the home office and all field offices.

The building was designed by Claud Beelman & Associates, with C. L. Peck serving as the General Contractor. The air conditioning was installed by the Air Conditioning Company of Southern California.

for LOWER COST, LOW TEMPERATURE REFRIGERATION
it will pay you to get the facts on
Creamery Package®
FACTORY-ASSEMBLED
2-STAGE AMMONIA COMPRESSOR SYSTEMS

- provide automatic day-and-night low temperature refrigeration
- use 25% to 50% less connected horsepower than with single stage
- cost substantially less to own and operate
- takes small floor space
- for hardening room, frozen confection and low temperature food freezing

GET DETAILS NOW . . . see your CP REFRIGERATION ENGINEER, or write

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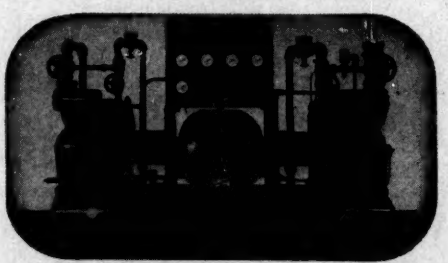
General and Expert Offices: 1243 W. Washington Blvd., Chicago 7, Ill.
Branches in 23 Principal Cities
CREAMERY PACKAGE MFG. CO. OF CANADA, LTD., 267 King Street, West, Toronto 2B, Ontario



CP TYPE K AMMONIA 2-STAGE COMPACT ASSEMBLED UNIT 4 cyl. 5 x 3½ Booster with 4 cyl. 3½ x 3½ High Stage Compressor direct connected to a 1160 rpm. 60 H.P. motor. Temperature range —25° F to —55° F; 23.3 to 9.4 tons refrigeration; 54.2 to 36.3 brake H.P.; CAPACITY EQUAL TO 9 x 9, 2-CYLINDER VERTICAL COMPRESSOR @ 330 RPM OPERATING SINGLE-STAGE WITH 75 TO 100 HORSEPOWER MOTOR.

CP TYPE V96-2 AMMONIA 2-STAGE COMPACT ASSEMBLED UNIT 6 cyl. 2¼ x 2 Booster with 2 cyl. 2¼ x 2 High Stage Compressor direct connected to a 1760 rpm. 20 H.P. motor. Temperature range —25° F to —55° F; 8.33 to 3.35 tons refrigeration; 21.5 to 14.60 brake H.P.; CAPACITY EQUAL TO 7 x 7, 2-CYLINDER VERTICAL COMPRESSOR @ 280 RPM OPERATING SINGLE-STAGE WITH 30 HORSEPOWER MOTOR.

Industry Meetings

Warehousemen — **April 25-28**

National Association of Refrigerated Warehouses, Inc.
American Hotel, Bal Harbour, Florida

Air Conditioning Conference — **Apr. 27-30**

Western Air Conditioning Industries Assn.
Shrine Exposition Hall, Los Angeles

Meat Packing — **May 12-15**

National Independent Meat Packers Ass'n.
Ambassador Hotel, Atlantic City

Cryogenics — **August 23, 24, 25**

Cryogenic Engineering Conference
Sponsored by University of Colorado
And Bureau of Standards
Boulder, Colorado

Dairy Show — **Oct. 31 to Nov. 5**

22nd Dairy Industries Exposition
With 8 Dairy Industry Organizations
Annual Meetings
International Amphitheatre, Chicago

Heating and Air Conditioning Show — **February 1961**

American Society of Heating, Refrigeration and Air Conditioning Engineers
15th International Exposition
Chicago, Ill.

Revised 3-A Standard for Farm Tanks Gets Committees' Approval

»» THE revised 3-A Sanitary Standards for Farm Milk Cooling and/or Holding Tanks was officially approved by representatives of all participants in the 3-A Sanitary Standards Committees, at their regular semi-annual meeting March 1 in Athens, Ga.

The revision will become effective on September 1, 1960. After this time, manufacturers of tanks may apply to the 3-A Symbol Council for authorization to use the 3-A Symbol on tanks complying with the new standard. The revised standard will be published in the June 1960 issue of the Journal of Milk and Food Technology.

3-A Sanitary Standards are developed in tri-partite conferences among sanitarians and public health officials, dairy equipment and supply manufacturers, and dairy processors. The program is entirely voluntary, but once a 3-A Sanitary Standard has been developed, its provisions are generally accepted in health and sanitary jurisdictions, without further modifications, in nearly every part of the United States and Canada.

Further information on 3-A Sanitary Standards may be had from the headquarters of any national dairy processor organization, or from the International Association of Milk and Food Sanitarians, or from Dairy Industries Supply Association.

lasts a lifetime!

Genuine Ozite pipe covering insulation installs easily on curves, fittings, straight pipes or valves . . . stops wasteful heat absorption effectively and permanently. Ozite insulation also helps maintain uniform temperature and increase your equipment's refrigerating capacity. Try Genuine Ozite!

A PRODUCT OF
AMERICAN HAIR & FELT COMPANY
MERCHANDISE MART • CHICAGO 54, ILLINOIS

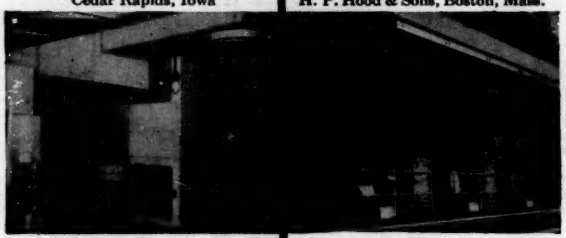
King

SHARP FREEZE SYSTEMS

increase hardening room capacity because they can be located anywhere

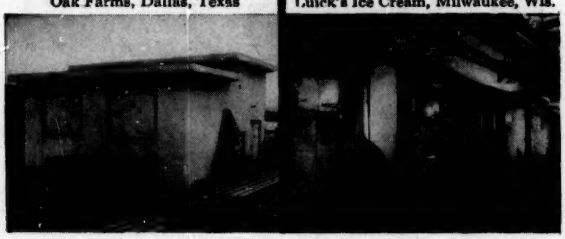
INSIDE *the room*
The Borden Company, Cedar Rapids, Iowa

OUTSIDE *the room*
H. P. Hood & Sons, Boston, Mass.



ABOVE *the room*
Oak Farms, Dallas, Texas

BELOW *the room*
Luick's Ice Cream, Milwaukee, Wis.

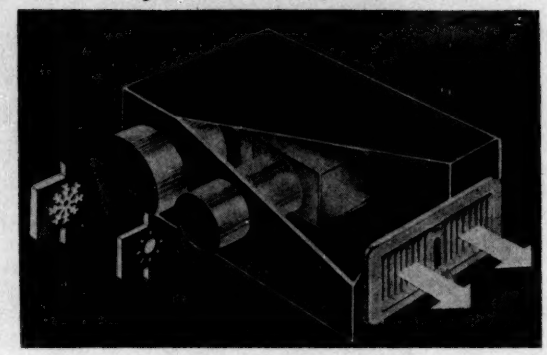


Over 60% of the nation's largest plants have found King Sharp Freeze Systems adaptable to their specific needs. King Systems feature fast, economical air defrost . . . each unit is defrosted 20 to 30 minutes, varying from once or twice a week to once a month. Reduced capacity periods before defrosting or interruption of normal operations during defrosting is entirely eliminated. ***Let us show you how to reduce the cost of operating your hardening rooms.***

Write for **K** *free technical bulletin. More than 50 years experience is at your service.*

King COMPANY OF OWATONNA
907 North Cedar Street
Owatonna, Minnesota

Ships Air Conditioned By New System In Netherlands



»» THE Netherlands, with a centuries-old seafaring tradition, has developed a modern device to make living on ships more comfortable.

The newly developed Du-O-Duct air conditioning system by the N. V. Bronswerk air conditioning and refrigeration division in Amsterdam permits individual temperature settings for each cabin.

In this system, the conditioned air is transported with high velocity through two round ducts to the cabin supply boxes. One duct carries conditioned air, the other reheated air. Adjustment of a mixing valve in the supply boxes permits individual temperature settings.

Standardized parts are used throughout, not only on the units themselves, but also for the ducts, insulation and cabin supply boxes. This makes for savings in installation labor costs, especially in the case of conversions.

Some ducts are rounded in order to reduce or eliminate pressure loss and resonance vibrations.

In the system installed on the Incres Line's "Victoria," a total of 8.8 million cubic feet of air per hour is treated, inducted or exhausted. Cooling capacity is supplied by two 225 hp centrifugal compressors by Worthington, with a cooling capacity of 5 million Btu. per hour.

Centrally placed in the ship, an air handling unit supplies the two conditions of air carried by the double duct system, to which a supply unit is connected in each space where temperature control is desired. In these units the two air supplies are mixed as necessary to permit rapid adaptation of the air delivered to changing conditions of sun radiation, electric lighting and the number of people present.

Features of the system, in addition to individual temperature control where desired, include appropriate heating of wheelhouse and sanitary spaces; continuous heating with low heat consumption; the possibility of 100 per cent fresh air ventilation; and centralized location of refrigeration and air conditioning plant.

No floor space is occupied in the conditioned compartments.

Small diameter tubes save weight and space, and they can be installed quickly and simply with standard bends, reducers, etc.

There is considerable reduction of work on the ship's general layout drawings. There are no extra electrical or piping requirements in the air conditioned rooms, and no extra power requirements for pump motors. The entire installation operates quietly.

The cabinet of the Du-O-Duct unit is rigidly formed from sheet steel. An air mixing damper, connected to a control knob on the front grille, is built into the unit.

Simple adjustment regulates temperature.

The noise factor has been reduced considerably, thanks to flowing branching, curved walls, and excellent surface of the special round ducting.

The unit is specially treated to resist corrosion. All outside surfaces are finished in grey zinc compound, and the drip pan is bitumastic-coated. Removable coils and filter permit easy inspection and cleaning.

On the central air handling unit, sectional construction has been used to permit easy handling, interchangeability and flexibility.

Controls Company of America Buys New Plant

»» CONTROLS Company of America, in a bid to streamline the manufacture of its heating and air conditioning controls and provide for future expansion, has contracted to acquire a former Chain Belt Co. ordnance plant—and adjoining land—in the Milwaukee area, George Becker, Controls Company vice president-operations announced today.

The former Chain Belt ordnance plant is an 8-year-old modern one-story building of brick and steel, contains 65,000 square feet of floor space, and is located at 4212 North 124th Street in Wauwatosa, a Milwaukee suburb. Its plot is slightly larger than seven acres.

Controls Company has also contracted to buy 82,800 square feet of property adjoining this plot from the R-W Co., a Wauwatosa construction firm, as a provision for future expansion, according to Becker.

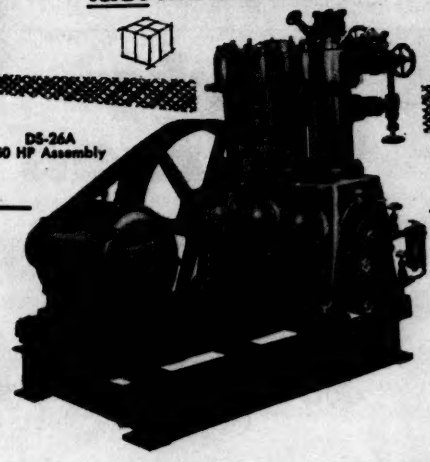
Controls Company currently maintains its Heating and Air Conditioning Division in two Milwaukee plants, one at 2200 North 31st Street, the other at 2450 North 32nd Street. Becker said that most of the 31st Street manufacturing operations will be moved to the new Wauwatosa plant in stages over the next six months. A few of the manufacturing activities and certain division functions will be transferred to the 32nd Street plant. After the moves are completed, he said, the 31st Street plant will probably be sold.

Becker emphasized that the moves will entail no personnel or product line changes. He also said he expects few if any employees to be added as an immediate result of the moves. Becker added that rising sales of heating and air conditioning controls will ultimately necessitate expansion of manufacturing facilities in the Milwaukee area, thereby creating more jobs.

The former Chain Belt ordnance plant was built in 1952 to manufacture 105 millimeter howitzers for the Government during the Korean war. Operations were discontinued in 1955, and the plant was on Government standby until 1958. It has been closed since 1958.

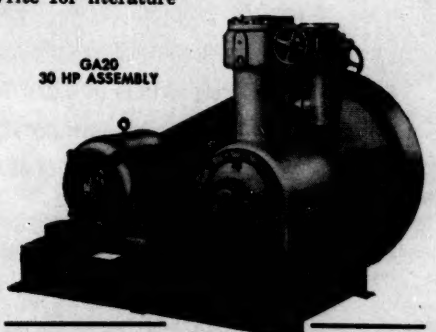
In addition to its Milwaukee area facilities, Controls Company of America maintains manufacturing and sales facilities across the United States and in Europe, Canada and South America. The Company specializes in controls systems for the aircraft, guided missile, computer, electronic, semi-conductor, vending, air conditioning, automotive, refrigeration, heating and appliance industries.

HOWE
COMPRESSOR
"PACKAGES"
assure
fast installation!



Factory-assembled with compressor, drive and motor on a steel base, HOWE'S compressor "package" can be completely installed in a matter of hours. In both standard and booster models with capacities to 60 H.P., these new HOWE assemblies sharply cut installation costs. They save time and space, and eliminate need for special foundations and expensive belt guards.

World-famous Howe Compressor qualities, with medium speed and long life, are now built into complete, compact assemblies. The know-how gained from nearly fifty years of refrigeration equipment manufacturing assures maximum efficiency at the lowest possible cost. Consult Howe today!
Write for literature



COMPRESSORS • ACCUMULATORS • CONDENSERS
UNIT, BRINE COOLERS • SURGE DRUMS • VESSELS
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HOWE
ICE MACHINE CO.
2829 Montrose Ave. • Chicago 18, Illinois
Distributors in Principal Cities. Cable Address: HIMCO Chicago

Recold Closed Circuit Evaporative Water Cooling

»» CONDENSING temperatures may now be controlled with Recold Closed Circuit Evaporative Water Cooling systems. The condensing temperatures may be controlled to within a very narrow range using single or any multiple of compressor systems, regardless of fluctuating ambient wet bulb or dry bulb temperatures.

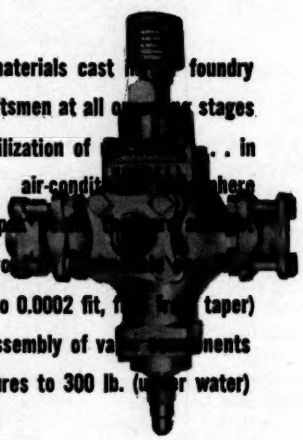
Constant condensing temperatures eliminate (1) the falling off of compressor capacity because of high head pressures, (2) burning of oil caused by high discharge temperatures, (3) overloading of compressor motors, (4) "flash gas" in the liquid line caused by low head pressure, (5) starving of expansion valves and evaporators caused by "flash gas"

In conjunction with this announcement, Recold has published a new Evaporative Water Cooler Multi-Unit selection work sheet (35E9c) which contains additional aids for use with the information already contained in Recold's Evaporative Water Cooler catalog (35C9c). Copies of this catalog and work sheets may be obtained by writing Recold Corporation, 7250 East Slauson Avenue, Los Angeles 22, California.

why read this ?

please don't... unless you're interested in eliminating "downtime" due to valve failures.

"Hubbell *service-free* controls" isn't just a slogan—it's really *true*. Here are a few of the steps we take to make it possible:



- ▶ finest materials cast [illegible] foundry
- ▶ skilled craftsmen at all [illegible] stages
- ▶ dimensional stabilization of [illegible] . . in air-condit[illegible]here
- ▶ use of specially designed "Drip[illegible] and moisture-pro[illegible]
- ▶ micro-honed bearing surfaces (to 0.0002 fit, f[illegible] taper)
- ▶ individual inspection and assembly of va[illegible]nents
- ▶ individual testing using air pressures to 300 lb. (u[illegible]r water)

A sample few of our manufacturing standards . . . all solid reasons to specify Hubbell on your next valve installation.

Service-free Controls

HUBBELL CORPORATION

MUNDELEIN, ILLINOIS

• BACK PRESSURE REGULATOR VALVES • DUAL PRESSURE REGULATOR VALVES • • AUTOMATIC SUCTION STOP VALVES • SOLENOID VALVES • GAUGES • • SAFETY RELIEF VALVES • 3-WAY REVERSING VALVES

"Castings to finished controls . . . every inch HUBBELL"

SYMBOL OF HUBBELL PRECISION CONTROLS

Stop at Hubbell Booth #812, Western Air-Conditioning, Heating & Refrigeration Exhibit Los Angeles, April 27-30

Niagara Blower Issues New Catalog

»» NIAGARA Blower Company has published a new catalog on evaporative condensers applicable to refrigeration and air conditioning installations from approximately ten tons refrigeration upwards. The special feature is a table from which selection of a correctly sized condenser can be made for Ammonia refrigeration in 46 sizes from 12 tons to 354 tons per unit and for Refrigerant-12 or 22 refrigeration in 23 sizes from 15 tons to 425 tons, at standard conditions. The book is illustrated with photographs of different types of condensers, important condenser features and diagrams showing construction and operation. Physical data includes general specifications, dimensions and weights. For copy write to Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.

ARI Publishes Standard For Sealed Compressors

A NEW ARI Standard for "Sealed Refrigerant Compressors and Condensing Units, 20 Horsepower and Smaller" has been published by Air-Conditioning and Refrigeration Institute, it is announced by Frederick J. Reed, Chief Engineer of the Air-Conditioning and Refrigeration Institute.

The new standard, numbered ARI Standard 515-60, replaces ARI Standard 320-56, for "Sealed (Hermetic-Type) Refrigerating Condensing Units, Five Horsepower and Smaller, for Commercial Application", which will be withdrawn from circulation.

Under its declaration of "purpose", the new standard states:

"The purpose of this standard is to establish, for sealed refrigerant compressors and condensing units, recommended specifications of what constitutes standard equipment; recommended minimum net volumes of liquid receivers; recommended minimum tube-connection sizes for liquid-line and suction-line shutoff valves; recommended requirements for testing and rating, including Standard Rating Conditions; recommended minimum performance requirements; provisions for safety; and recommended installation and service instructions."

Covered under the document, which is intended for the guidance of the industry, including manufacturers,

distributors, installers, contractors, and users, are sealed electric-motor driven refrigerant compressors, as well as air-cooled, evaporatively-cooled, and water-cooled sealed condensing units twenty horsepower (nominal) and under. It applies to sealed refrigerant compressors and condensing units using Refrigerants 12 and 22.

Issuance of ARI Standard 515-60 is in line with the present reorganization of ARI Product-Sections, under which the Centrifugal Liquid-Chilling Packages Section, the Reciprocating Compressor and Condensing Unit Section (with three sub-sections), and the Reciprocating Liquid-Chilling Packages Section, were created, and two previously-existing sections—the Small Compressors Section and the Air-Conditioning and Refrigeration Systems Section—were dropped, their members transferring to the applicable new sections or sub-sections.

Two other new ARI Standards are scheduled for publication early in 1960 in connection with these changes. The new ones will be:

ARI Standard 511-60, Ammonia Compressors, whose publication will result in the withdrawal of the present Standards 5-12, Enclosed Ammonia Compressors, Vertical Single-Acting Type; 5-13, Performance of Ammonia Compressors, Vertical Single-Acting Type; 5-14, Standard Equipment for Ammonia Condensing Units, and 5-15, High-Speed Ammonia Compressors.

ARI Standard 516-60, Refrigerant 12 and Refrigerant 22 Compressors and Condensing Units, 25 Horsepower and Larger, which will replace existing standards 5-21, "Freon" Compressor Units, 25 Horsepower and Larger, and 5-22, "Freon" Condensing Units, 25 Horsepower and Larger.

The new Standard 515-60, which was developed by ARI's Engineering Department under the supervision of the Reciprocating Compressor and Condensing Unit Section, is available from ARI at 25 cents per copy.

Halstead & Mitchell In Market For Larger Size Units

>>> HALSTEAD & Mitchell Company is extending its equipment line to meet demands for higher tonnage jobs in industrial applications. Horace I. Schmidt, general sales manager of the Pittsburgh, Pennsylvania, firm, is directing company efforts in engineering and sales to take advantage of a market for the company's large size equipment that is growing at an even more rapid rate than the industry growth pattern.

"Our cooling tower line now includes a 150-ton model, almost double the size of the largest unit offered three years ago," Mr. Schmidt stated. "Similarly, in our air-cooled condenser line, we now offer single-fan condensers with a capacity of 50 tons. We are selling a large number of manifolded units because multiples of all of our condensers can be put together for use on jobs that range well upwards of 100 tons. Even our new line of air handlers," Mr. Schmidt pointed out, "are being supplied for capacities up to 47,500 cfm. We have made provision for the inclusion of cooling or heating coils up to 12 rows in depth."

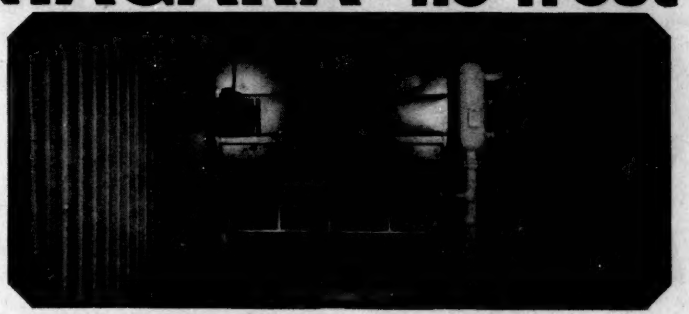
Halstead & Mitchell's product line includes cooling towers, water-cooled condensers, air-cooled condensers, finned surface coils, and air handling equipment. It is designed to provide customers with a single source of supply for all of their many needs.

Catalog and Price List on Plastic and Filament Packings

>>> THIS revised catalog and price list offers extensive information on the 14 distinctive types of Palmetto Fabric, Foil, Plastic and Filament Packings. These packings are available in 9 unique constructions which are illustrated in large cutaway detailed drawings on the inside front cover and repeated throughout the catalog pages. Specially designed for service with strong acids, corrosive fluids, solvents, steam, air, ammonia, gases, hot or cold water, chemicals, oils, gasoline, superheated steam, hot gases and oils; they are used on pumps, valves, valve stems, reciprocating rods and pumps, oscillating and rotating shafts, pistons or plungers and expansion joints. General data lists details on composition, application, service information, and temperature limits (up to 1200F) for each type of packing; plus tables of sizes (from 1/8" to 1", in gradations of 1/16 of an inch), lengths, weights, standard packagings and prices. The catalog also includes a section which gives simple, easy-to-follow how to order instructions. Other Palmetto lines . . . Self-Lubricating Packings, Molded Packings, Gasketing and Gaskets . . . are illustrated on the back cover.

For additional catalogs and specific engineering services, contact: Greene, Tweed & Co., North Wales, Pennsylvania.

NIAGARA "no frost"



GET THE BEST QUALITY IN FROZEN FOOD

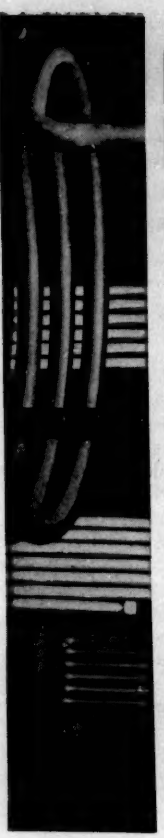
● Operating men, who know both costs and profits, will tell you that Niagara "No-Frost" gives you the best operation in frozen foods... both in freezing and in warehousing where trustworthy, safe storage temperatures must be combined with building layout that lets you *move* goods... not just store them. Only Niagara methods give you safe and even temperatures with over 20' head room so that you can use your fork lift trucks and palletized warehousing efficiently. And "No-Frost" refrigeration shows the lowest upkeep costs in the business.

Write for Bulletin No. 105

NIAGARA BLOWER COMPANY

Dept. IR-4, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities



PIPE BENDS

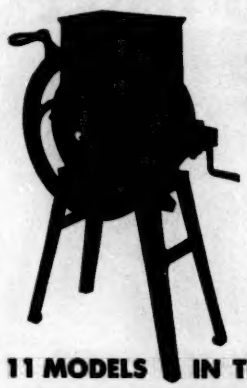
Coils, Headers and Fabrications . . .

the tougher the job, the better our expert metalworkers like it. With their modern equipment, they produce the finest work to your precise specifications. In any metal, even stainless steel, or up to 6-inch extra heavy. For fast, quality bends, backed up by more than 40 years specialization, call on us!

May we quote on your next job?

CHICAGO NIPPLE

MANUFACTURING CO.
1997 Clybourn
Chicago 14



Little Giant Model 90M

11 MODELS IN THIS LINE OF ICE BREAKERS FOR:

RESTAURANTS • HOTELS • AIR LINES
RAILROADS • LABORATORIES • TAVERNS
ICE PRODUCERS • PACKING HOUSES

The Little Giant Line has a long record of service to many types of users. These breakers are designed to break ice in rice to chestnut to 3" size and pea to chestnut to 4½" size. Hand and power operated. Write for details and prices.

LITTLE GIANT

DEPENDABLE ICE BREAKERS BY MICRON, INC., BETTENDORF, IOWA

McIntire Catalog

»» THE Refrigeration Division of The McIntire Company, Livingston, New Jersey announces a new Catalog No. R-59, covering items for the refrigeration and air conditioning industry including driers, filters, strainers, liquid indicators, water regulating valves, water bubblers, hoses, clamps, clips, straps, and hangers.

Air Drying Brochure

A NEW 16-page brochure, printed in 3 colors, describes the latest model (Model C) Kathabar Air Conditioning and Drying Systems. The equipment is used to stop condensation; speed drying and other processing operations; obtain sub-freezing dewpoints; make air sterile to hospital standards.

The brochure also covers the new Kathabar climate control rooms. These prefabricated standard test rooms are designed to establish and produce almost any temperature, humidity and bacteria controlled conditions desired for product testing.

Request bulletin K-160 from: Kathabar Air Conditioning and Drying Systems, Surface Combustion Division of Midland-Ross Corporation.

Vilter Appoints New Sales Representative

»» JACK Deroche has been appointed a sales representative by The Vilter Manufacturing Company, Milwaukee Wisconsin, manufacturer of refrigeration and air conditioning equipment. In this capacity he will serve Vilter customers and distributors in the Milwaukee and Madison, Wisconsin areas.

J. Deroche

Deroche has recently completed an extensive training program at the company's Milwaukee office. He attended the Illinois Institute of Technology and the University of Illinois, obtaining a B.S. degree in Mechanical Engineering and Naval Science from the latter in June, 1955.

Upon graduation, he received a commission in the United States Naval Reserve as ensign and served two years as engineering officer aboard a radar picket ship.

He is a member of the American Society of Mechanical Engineers, the American Society of Heating, Refrigeration and Air Conditioning Engineers, and is a senior lieutenant in the Naval Reserve.

Kramer Trenton Appoints A. Rose To Sales Staff

»» PETER A. Rose has been appointed to the engineering and sales staff of the Kramer Trenton Company, it was announced by S. Charles Segal, Kramer general sales manager. Rose is Southeast area representative with headquarters in Atlanta, Ga.

P. A. Rose

He brings to Kramer Trenton a decade of engineering and managerial experience. He was formerly chief engineer for Larkin Coils Inc. in Atlanta, Ga.

A graduate of the Georgia Institute of Technology, Rose holds a B.S. degree in Physics and an M.A. in Science. While working for his Master's degree he was an instructor in college physics at Georgia Tech. He also taught for a year in the Evening College of the University of Georgia.

He is a member of the American Society of Heating, Refrigerating and Air Conditioning Engineers and Sigma Pi Sigma, national physics society.

New Plant Superintendent For American-Standard

»» APPOINTMENT of Gordon Parrington as plant superintendent has been announced by Raymond Lee, Dearborn plant manager for American-Standard Industrial Division, producer of air conditioning and air handling equipment.

A graduate of the University of Michigan, Parrington holds a B.S. degree in engineering. He joined the Industrial Division in 1956 as general foreman, a position he held at the time of his new appointment.

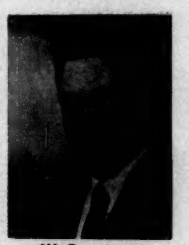
Parrington's business background includes broad experience in manufacturing and plant management. Among his former associations are 4 years as plant manager with Draper Motor Corporation and 2 years as plant manager with Wright Products Corporation prior to joining American-Standard.

Copeland Names Three To New Posts

»» ERNEST Kroder has been appointed chief engineer of the standard products line by Copeland Refrigeration Corporation.

Kroder was formerly associated with the Lehigh Manufacturing Company as general manager, special products, the Keeny Manufacturing Com-

E. Kroder



W. Runciman

A. Perttola

pany and the Bridgeport Brass Company.

He is a graduate of the Bridgeport Engineering Institute, a member of the American Society of Mechanical Engineers and the American Ordnance Association.

Walter Runciman, former service manager of Brunner Division, Dunham-Bush, has joined Copeland Refrigeration as assistant to Glenn Detrick, national service manager.

Runciman was associated with Brunner for nearly eight years as sales engineer and service manager. A graduate of McGill University, Montreal, he is a member of ASHRAE and the National Service Managers' Club, RSES.

Arne Perttola, formerly assistant to Detrick, has been appointed manager of field educational services. Prior to joining Copeland in 1956, he operated a compressor repair and re-building service in Detroit, Michigan. In his new capacity, Perttola will be responsible for compressor and condensing unit field service and rebuilding procedures.

Du Pont Makes New Sales Assignments

>>> DU PONT'S "Freon" Products Division has announced a series of changes in assignments of its technical sales representatives.

Robert A. Geuting has been assigned to the division's Chicago office, William B. Gest to Cleveland, Lawrence R. Sullivan to New York, and Patrick B. O'Donnell to a new sales territory in the Houston area.

Mr. Geuting, who has been the division's Cleveland area sales representative for the last four and a half years, is a native of Denver, Colo.

Mr. Gest, a native of Covington, Ky., and a graduate of Ohio State University, has been associated with the Du Pont Company since 1941 when he began six years of varied engineering assignments in explosives plants operated by Du Pont for the U. S. Government.

Mr. Sullivan, a native of Newark, N. J., and a graduate of Worcester Polytechnic Institute where he obtained his bachelor of science degree in chemical engineering, joined the Du Pont Company's Petroleum Chemicals Division as a sales representative in 1951.

Mr. O'Donnell, a native of Kincasslagh, County Donegal, Ireland, attended St. Columbus College in Londonderry and the College of Technology in Belfast before coming to the United States in 1949. After working for a short time as a paymaster with the United Nations at Lake Success, N. Y., and taking graduate work at Columbia University, he joined the Treasurer's Department of the Du Pont Company in 1951.

Classified Advertising

All classified advertisements are payable in advance. Except for Positions and Help Wanted classifications, this section is reserved exclusively for USED equipment.

RATES: 20c per word; minimum 25 words. $2.00 per line for bold face headings: $15.00 per inch for line listings.

Position and Help Wanted

WANTED—Ice Plant operating engineer. Must be experienced with ice making plants operating with ammonia compression system. Write or call Mr. J. H. Rustman, Jefferson Ice Co., 6625 Avondale Ave., Chicago 31, Ill. Phone SP 4-3300.

USED EQUIPMENT—wanted & for sale

WANTED— 350 tons refrigeration compressors for export—preferably York or Frick. Must be available for immediate delivery. Give all details in first letter; no dealers. Address Box MR-6, c/o Industrial Refrigeration.

FOR SALE

200 h.p. Worthington water chilling unit.
25 h.p. York brine chilling unit.
(2) 11x9 York booster comp. 60 h.p. ea.
10x10 & 9x9 York compressors V-belt drive.
Type 100 F & E automatic ice cuber.
100 h.p. 280 volt, variable speed, DC motor, with controls.

JOHN F. CARSON
A & Venango Sts. Philadelphia 34, Pa.
GArfield 6-2221

REFRIGERATION EQUIPMENT FOR SALE
Advise Us Your Needs
Use QUICKSEAL—stops brine tank leaks.
Use CLERTEMPICE—clears and tempers ice.
Born Company 80 East Jackson Boulevard.
Chicago 4, Illinois. WAbash 2-3299.

FOR SALE—McQuay aluminum fin coils 18" wide 3" deep with ¼" spacing 11' long. Used, but in excellent condition. Make us an offer. Kress Packing Co., Inc. Waterloo, Wisc.

FOR SALE—CLOSED FOOD PROCESSING PLANT IN CLEVELAND, OHIO offers 1950 Vilter ammonia compressors, also Marley room coolers, shell and tube condensers, etc. Compressors range from 10-1/2x10-1/2—7-1/2x 7-1/2. Write for complete listing to JACO Equipment Corp., successors to Chas. S. Jacobowitz Corp., 3080 Main St., Buffalo 14, N.Y. 'phone AMherst 2100.

FOR SALE

1— Frick 10x10 compressor, 100 h.p. motor V-belt drive.
1— Vilter 10x10 compressor, 100 h.p. motor, V-belt drive.
1— York 8x8 compressor, 50 h.p. motor.
1— Worthington 15x12 air compressor, 75 h.p. GE synchronous motor.

All in excellent condition. Ready for delivery January 30, 1960. Inspection by appointment. Write Box MR-4, c/o Industrial Refrigeration.

FOR SALE—AMMONIA EQUIPMENT

2— 15 ton Frick ice making plants (New).
1— 300 lb. Gifford Wood ice cubing machine.
1— 11"x13" 4-cyl. York Duplex DC to 250 h.p. motor.
2— 10"x10" 4-cyl. Carbondale Duplex DC to 225 h.p. motor.
3— 10"x10" 4-cyl. Frick Duplex DC to 175 h.p. motor.
1— 9"x9" 4-cyl. York Duplex DC to 150 h.p. motor.
4— 10"x10" 2-cyl. York DC to 100 h.p. motor.
1— 9"x9" 2-cyl. York DC to 75 h.p. motor.
2— 10"x10" 2-cyl. Yorks with V type flywheel.
1— 9"x9" 2-cyl. York with V type flywheel.
2— 7½x7½ & 8½x8½" 2-cyl. Vilters.
3"x3", 4"x4", 5"x5" & 6"x6" York and Frick compressors.
3"x3", 4"x4" & 5"x5" York condensing units.
6— York floor type blower unit coolers.
11"x22"x47" 300 lb. ice cans.
75, 100, 150 & 200 ton ice making plants.
8— shell & tube condensers, 25 ton capacity.

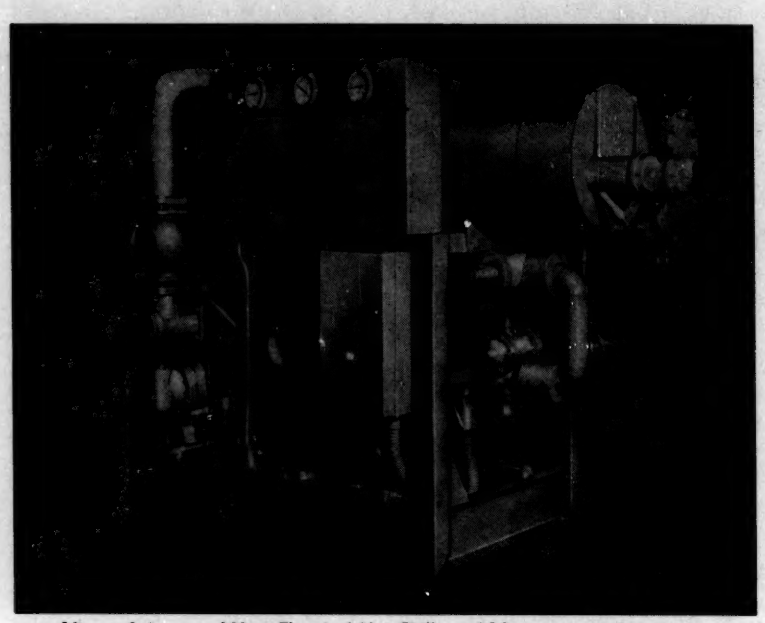
ENTERPRISE EQUIPMENT CORPORATION
328 Bryant Ave., Bronx 59, N. Y.
Cable "ENTREMA" Phone DAyton 8-2121.

FOR SALE—Goebel Brewery, Muskegon, Mich., closed; York 7-1/2x7-1/2, 8x8, 9x9 with AC motors and starters; recently reconditioned, all still installed; inspection invited; tremendous bargains. Write for complete listing of all ammonia compressors, room coolers, etc. to JACO Equipment Corp., successors to Chas. S. Jacobowitz Corp., 3080 Main St., Buffalo 14, N.Y. 'phone AMherst 2100.

Ice Plant For Sale

PLANT FOR SALE—Seashore ice manufacturing plant, lockers, cold storage, oil distributorship, coal distributorship. Long term lease on cold storage. One of the finest blast freezers on Atlantic Coast. Ice vendors, bagging equipment and other equipment. Modern. Low amount of cash required. Write Box AP-3, % Industrial Refrigeration.

Air conditioning made easy with new space-saving fully flooded Vilter Chiller



View of the new Vilter Flooded Uni-Chiller—100-ton nominal capacity.

Compact, space-saving design, low cost and a flooded water chiller are some of the important advantages of the new Vilter flooded type Uni-Chiller.

While especially suited for air conditioning applications, Uni-Chillers fit readily into almost any liquid chilling system.

Four standard sizes are offered—25, 50, 75 and 100-ton nominal capacities.

All components are sized to operate efficiently as a system. The flooded-type shell and tube cooler and the condenser are mounted above a rugged Vilter VMC compressor. Shipped assembled, the Uni-Chiller arrives with all interconnecting piping completed, controls factory wired, cooler and low-temperature piping insulated and a holding charge of refrigerant.

Motor and starter can also be supplied by Vilter and if desired, the compressor and motor can be run-in and all controls and gauges properly adjusted and set. By specifying a completely assembled unit, installation costs and start-up time are reduced... real savings to you.

Why not contact your nearest Vilter representative or write directly to Vilter for full details and application recommendations.

Vilter refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin
Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

We will be pleased to send you complete details on the above equipment.

Write Vilter Dept. J-913

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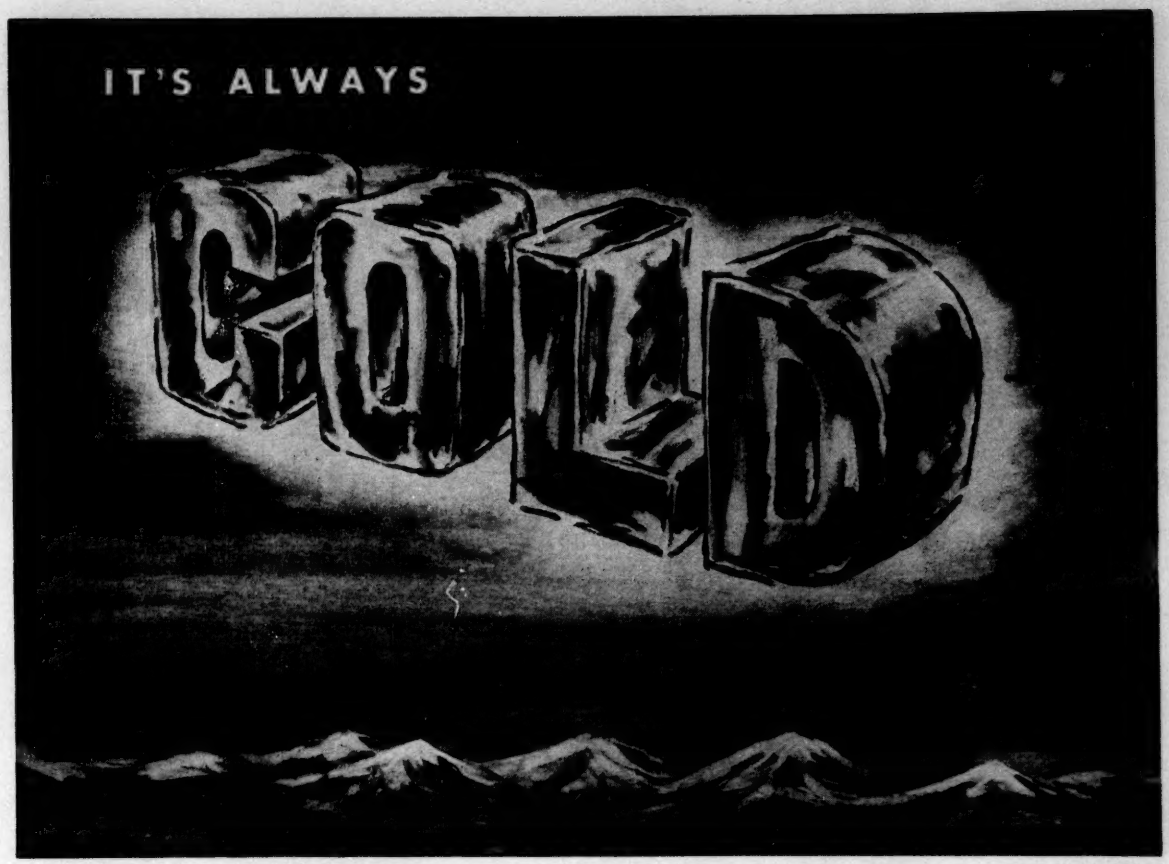


And SAFEWAY Heating Blankets and Elements solve cold problems wherever they exist!

Maybe it's a basic defrosting problem in industrial refrigeration . . . or perhaps it involves the vital protection of aircraft from the icy upper atmospheres.

For these and scores of in-between applications, Safeway provides a *controlled heat* product, regardless of environmental temperatures. And people who know refrigeration depend on Safeway Heat Elements as a completely reliable and economical solution to defrosting problems in the commercial and industrial field.

Safeway's modern manufacturing facilities are devoted *exclusively* to the design, engineering and application of *controlled heat* for industry. Among the wide variety of Safeway heating blankets, woven and molded heating elements are:

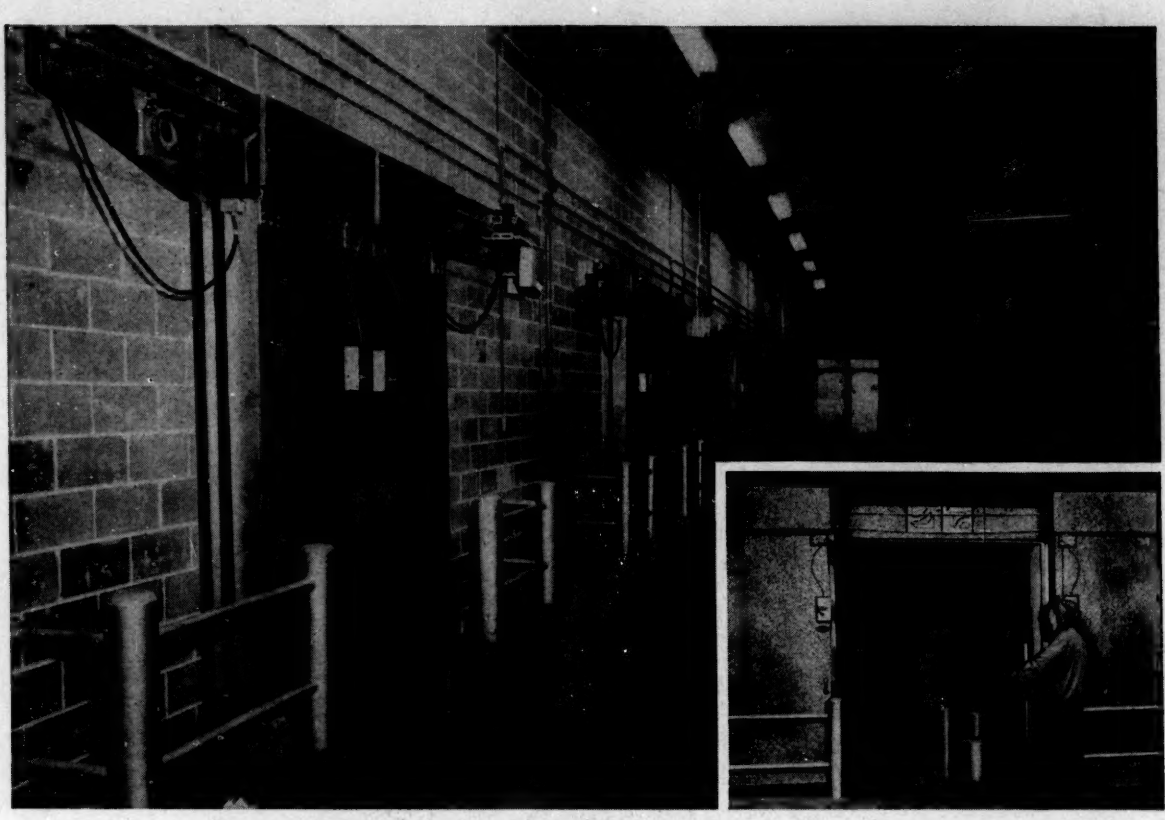
- **heating elements for launching equipment and for airborne gyros, cameras, computers, servos and batteries — for missiles or aircraft**
- **de-icing units for airfoil surfaces**
- **heating elements for all types of ground support equipment**
- **defrosting units for industrial and commercial refrigeration**
- **heating blankets for honeycomb and metal-to-metal bonding**

For your copy of a fact-filled folder, please write:

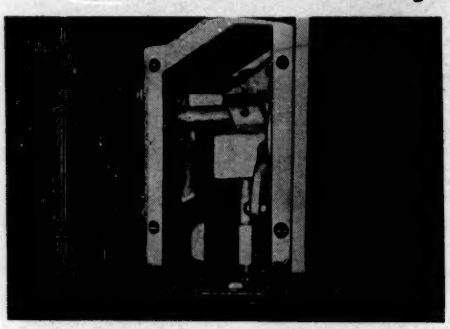
If it has to be heated (and the "it" can be just about anything), you can rely on SAFEWAY engineers to study your problems carefully, and — without any obligation — submit an appropriate recommendation.

Safeway HEAT ELEMENTS INC.

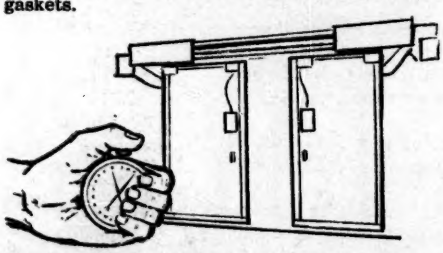
Middlefield Street • Middletown, Connecticut



9 Jamison Electroglide® Doors handle heavy traffic—save refrigeration



COMPRESSION SEAL—refrigeration savings assured by cam lock—in and down action on gaskets.



SMOOTH, SHOCK-FREE OPERATION—exclusive Electroglide spring cushion chain link absorbs inertia on opening, absorbs momentum when stopping.

Insulator: Mid Continent Industrial Insulation Co., Kansas City, Kansas.

Contractor: A. W. Soderberg Construction Co., Wichita, Kansas.

• In Wichita, Kansas, at the big Safeway Cold Storage Warehouse, nine Jamison Electroglide Power Operated Cold Storage Doors demonstrate how they permit high volume, high speed warehouse operation.

Exclusive Jamison features of the Electroglide assure fast, positive operation with safety to personnel.

LEVEL RIDE—opening and closing without gasket wear or drag.

RANGE OF TYPES—available bi-parting and single leaf left or right hand operation.

PADLOCK WITH SAFETY—emergency inside release.

MANUAL OPERATION—possible when power is off.

For Electroglide bulletin—Write Jamison Cold Storage Door Co., Hagerstown, Md.

JAMISON

COLD STORAGE DOORS